MATANGIA ‘I NAMO –
Science Teachers’ and Students’ Conceptualisations of Local Environmental and Climate Change Issues: Talanoa from Ha‘apai and Port Vila

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy at the University of Canterbury, Christchurch, New Zealand

Supervisors: Dr Richard Manning and Professor Steven Ratuva

by

Emma Christine Puloka Luey

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Abstract

Pacific communities in both rural and urban settings are experiencing the impacts of the global climate crisis, as well as non-climatic factors, on their local ecosystems. Developing adaptation strategies to respond to these threats of disasters requires knowledge of local ecosystems and community needs. The findings of this thesis indicate that one way of deepening our understanding of climate and environment is the use of Indigenous knowledge systems passed on through familial and village settings. This thesis also suggests that the current science education in formal schooling marginalises Traditional Ecological Knowledge and Indigenous languages in Haʻapai (Tonga) and Port Vila (Vanuatu). There is indeed a need to align the science education in Pacific schools with the values, knowledge, cultures and languages of local communities, acknowledging their connectedness to place and the science learning opportunities this presents. Through a series of talanoa in Haʻapai (Tonga) and Port Vila (Vanuatu), this research explores how Year 10 students and teachers in these contexts conceptualise local environmental issues in the context of their experiences, cultural knowledge and sense of connectedness to place. This research calls for collaboration and dialogue between schools and communities about how Indigenous knowledge of environmental and climatic issues can be meaningfully incorporated into the current western curriculum.

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Dedication

A dedication of this Moana research journey taken from Hymn 410 of the Free Weslyan Church of Tonga Hymn Book:

Ta'etāu 'a hoku vaka
Mo e fu'u folau 'i vaha;
Ko e vaka vaivai fu'u ,
Tāu pe ke fai he ū
Pea kapau 'e fou kitu'a
'Ao pe ke vaka ua
Sisu, ofi 'ia au
Lolotonga 'a e folau

Such un-seaworthy a vaka that I am
Ill-equipped and unprepared for ocean voyaging
Only shallow-sheltered waters I would try
Until Jesus came on-board my vaka
Now I would dare venture out
Into the deep, deep ocean of life
A refuge and safe harbour for my vaka

(Translation by Dr. Viliami Puloka)

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List of Abbreviations

CCE – Climate Change Education

EbA – Ecosystem-based Adaptation

EE – Environmental Education

ERHEC – Educational Research Human Ethics Committee

ESD – Education for Sustainable Development

PBE – Place-Based Education

RPEIPP – Rethinking Pacific Education Initiative for Pacific Peoples by Pacific Peoples

SPBEA – South Pacific Board for Educational Achievement

SPC – Secretariat of the Pacific Community (now known as Pacific Community)

SPREP – Secretariat of the Pacific Regional Environment Programme

TC(s) – Tropical Cyclone(s)

TEK – Traditional Ecological Knowledge

TKS – Traditional Knowledge and Skills

TSD – Tonga Statistics Department

TSTL – Traditional Scientific and Technological Literacy

UNESCO – united Nations Educational, Scientific and Cultural Organisation

UN OCHA – united Nations Office for the Coordination of Humanitarian Affairs

USP – University of the South Pacific

VCC – Vanuatu Cultural Centre

Chapter 1 : Introduction

Pikipiki hama kae vaevae manava

Link the outriggers of our canoes so that we can share our provisions with one another

Tongan Proverb (‘Ahio, 2011, p. 72)

Overview

As a Tongan teacher-researcher, I embarked on this research journey amidst a global climate crisis and growing calls to respond to this crisis by contextualising the schooling systems of Pacific Island nations. Subsequently, this thesis addresses questions about whose languages, cultures and knowledge systems are privileged by science education syllabi across the Moana (Pacific Ocean). This study reflects my own concerns as a Tongan teacher regarding whether or not schooling in the Pacific is preparing students for meaningful engagement with the ecological realities their communities now face. As the title of this thesis (Matangia ‘i Namo) suggests, due to climate change, we are being overcome in our supposedly safe places (M. Puloka & V. Puloka, personal communication, May, 2021). To provide a sense of direction, this opening chapter first outlines of the aims and rationale of this research. Next it proceeds to summarise the qualitative nature of research design which underpinned this study. Finally, this chapter outlines the content of each chapter that follows this Introduction chapter.

Research aims

In summary, this study sought to explore:

(a) How secondary school science students in Ha‘apai (Tonga), and Port Vila (Tonga) conceptualised local environmental issues and to what extent these reflect both their Indigenous knowledge context and formal schooling pedagogy.

(b) The pedagogical and educational approaches used by teachers to teach local environmental issues in their science classes and the implications of this on the wider issues of climate change education;

(c) The role and significance of Indigenous knowledge in understanding the environment and climate change and how this can be incorporated into the western models of science education.

Rationale

This research can be viewed as a teacher-researcher’s response to the growing challenges posed by climate change, which research suggests now threatens livelihoods in Pacific communities – particularly those already inhabiting fragile ecosystems because of

societal changes. The Intergovernmental Panel on Climate Change (IPCC) *Special Report on the Ocean and Cryosphere in a Changing Climate* argued that, along with sea level rise, coastal ecosystems are impacted by:

> climate-related ocean changes, and adverse effects from human activities on ocean and land *(high confidence)*. Attributing such impacts to [sea level rise], however, remains challenging due to the influence of other climate-related and non-climatic drivers such as infrastructure development and human-induced habitat degradation *(high confidence)* (Oppenheimer et al., 2019, p. 323).

Pacific climate change adaptations must include rural communities and recognise traditional knowledge in Indigenous communities which has helped them navigate changes in the past, although now climate change also poses new challenges and modernisation and consumerism having eroded this traditional knowledge base (Weir et al., 2017). Local actions in contemporary Pacific Island communities also compromise local ecosystem health. Such actions include the processes of:

(i) urban expansion (Morrison et al., 2013);

(ii) (ii) intensified agriculture and fishing practices (Purcell, 2014; van der Velde et al., 2007) and;

(iii) (iii) mining opportunities (Sato, 2014).

The complex myriad of "climate-related and non-climatic drivers" (Oppenheimer et al., 2019, p. 323) of ecosystem degradation require Pacific peoples to think critically about both local and global patterns of production and consumption, which affect our Pacific shores.

Vanuatu and Tonga are both parties to the Convention on Biological Diversity (CBD) and accordingly have developed the *National Biodiversity Strategy and Action Plans* (Tonga Department of Environment, 2020; Vanuatu Department of Environmental Protection and Conservation, n.d.). This convention represents "commitments for maintaining the world's ecological underpinnings as we go about the business of economic development. The convention establishes three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources" (Secretariat of the Convention on Biological Diversity, 2000). Vanuatu and Tonga are also parties to the United Nations Framework Convention on Climate Change (UNFCCC).

The Vanuatu National Advisory Committee on Climate Change (n.d.) asserted that land and environment are integral to the Ni-Vanuatu culture and that "there is a recognition for the need to strengthen existing customary measures to sustain the environment" (p. 15). In Tonga,

agriculture is a culturally significant activity and it generates most of the country's jobs, highlighting the importance for adaptive and sustainable practices which are also needed in the fisheries sector since the advent of commercial fishing and the uptake of modern technologies (Tonga Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications, 2019). In an era of changing cultures and climate, the concept of biocultural diversity should be given adequate attention.

The links between biological and cultural diversity highlight the growing need for Indigenous peoples to play a leading role in global conservation initiatives, given their traditional practices have often preserved biodiversity (Maffi, 2005). The "close and traditional dependence of Indigenous and local communities on biological resources" (Secretariat of the Convention on Biological Diversity, 2000, p. 15) has been recognised by concepts such as planetary health which alert all communities to the dependence of human health on ecosystem health (Whitmee et al., 2015). These reflect the wisdom embedded in Indigenous conceptualisations of the environment such as the Tongan concept of fonua which, with variants in other Pacific cultures, means "land and its people and their on-going relationships" (Tu'itahi, 2005, p. 19). This highlights the importance of Indigenous cultures to environment and climate concerns and, as a teacher, realising this leads me to question how local Indigenous cultures inform science education in schools based on colonial models in the Pacific.

Cajete (2020) makes the assertion that Traditional Ecological Knowledge (TEK), also known as Indigenous Knowledge, helped Indigenous communities survive in the ecosystems they lived in. TEK is largely communicated in Indigenous languages, now threatened by globally dominant languages (Hough & Skutnabb-Kangas, 2005). The concept of biocultural diversity, therefore, illuminates the intersections that exist between biodiversity, cultural and linguistic diversity, and the threat of homogenising forces. As one researcher has noted:

> Biocultural homogenisation is both a driver and a product of complex and interwoven losses of biological and cultural diversity at local, regional, and global scales, which are taking place at accelerating rates in the Anthropocene. Despite its pervasiveness, the problem of biocultural homogenization is not fully understood, and its impact not widely recognised (Rozzi, 2018, p. 22).

Against this backdrop, it was not surprising to find that schooling has been associated with the loss of (Indigenous peoples') vernacular language and culture erosion across the Moana – even in sites of high linguistic diversity – like Vanuatu (McCarter and Gavin, 2014). Although the credentials offered by schooling throughout many Pacific nations are highly sought after, there have been strong calls to critically examine the knowledge and values being

passed on by curricula guidelines which have marginalised local knowledge in favour of the global (Palefau, 2005; Puamau, 2004; Thaman, 2003). The marginalisation of local and/or Indigenous peoples' knowledge is problematic given the environmental challenges plaguing the Pacific. As stated previously, a growing body of recent research highlights the importance of local and traditional knowledge in disaster risk reduction procedures and developing durable programmes to support community resilience (Janif et al., 2016; Mercer, 2010; Walshe & Nunn, 2012).

Schools may, however, also hold the potential to be transformed to become sites of synergy that can interweave local peoples' traditional knowledge and western scientific approaches (Filous et al., 2021). In the same vein as a growing body of place-conscious education literature (cited in Chapter 3), my doctoral research was designed to explore how teachers of science, and their students, conceptualise local environmental issues in Ha'apai (Tonga) and Port Vila (Vanuatu).

The communities in both case study sites had recently experienced devastating Category 5 Tropical Cyclones (TCs). Hence, I chose to conduct research in these sites because I anticipated that potential participants would wish to share dramatic and immediate experiences climate change upon their families and discuss the relevance of their two countries' respective science curricula and/or offer positive alternatives considering this. To undertake such work, I felt an eclectic form of qualitative research was necessary.

Qualitative research design

In contrast to positivist quantitative research, qualitative researchers (who lean towards interpretivist and phenomenological models of research design) are interested in understanding social phenomena or reality as people perceive it (Taylor et al., 2015). Given that my primary research objective was to explore student conceptualisations of local environmental issues, and how teachers frame these issues (and within the constraints of their official curriculum guidelines and resourcing), it seemed logical to employ a broad approach. This would provide a degree of flexibility I felt was necessary to allow me to draw upon a diverse range of methodologies.

According to Creswell (2012), qualitative researchers acknowledge that there are multiple realities and carry out their inquiry with the intent of presenting those of their participants. As will be explained in greater detail during Chapter 3, my qualitative inquiry was designed to explore, analyse and present students' conceptualisations of local environmental issues and how these same environments are framed in secondary science education by their

science teachers. To that end, I would draw upon student and teacher participants' narratives of their respective educational experiences in two case study settings: Ha'apai (Tonga) and Port Vila (Vanuatu). I would also draw upon primary and secondary sources (i.e., official documents and other research) that I would collect from my two fields of study.

The collection and analysis of data was subsequently conducted in ways designed to ensure the participants' narratives of each case study were not forced into a box for my 'ease of comparison' but investigated in all their complexities (Bogdan & Biklen, 2007). As a novice teacher-researcher, I determined that qualitative inquiry offered the best toolkit to assist me to seek understanding in the case study contexts concerned. These are places where I have not taught or studied, despite being connected to them by various cultural/genealogical links. Due to the nature of my research objectives, I also felt a qualitative approach was the most appropriate to adopt because its flexibility would allow for the collection of additional data as I began to spend more time in each context, and became better positioned to decide what additional literature I needed to collect to make sense of the narratives presented to me (Taylor et al., 2015).

Consequently, the qualitative design of this research allowed me to be flexible and fluid in my inquiry, positioning myself as a student of each case study site and to adjust my research plan as I learned more from the participants. Furthermore, this approach enabled the participants' voices to propel my inquiry forward in a range of previously unanticipated directions. Being a Tongan teacher-researcher conducting research in the Pacific, it was also important to place my Tongan epistemologies and ontologies to the fore of the research – to provide transparency and acknowledge my limitations. In hindsight, I am confident that this approach has helped me to gain trust and to relate to the participants, as a fellow person of the Moana (Pacific Ocean).

Qualitative research approaches were also the best aligned to my efforts to explore teachers' conceptualisation and framing of local environmental issues. These approaches (as discussed in more depth later in Chapter 3), best positioned me to focus on understanding how people make meaning and to 'hear' and 'feel' what marginalised peoples' voices are saying (Liamputtong, 2020). As common with other qualitative research, mine focused on participants' "experience and interpretation" of local environmental issues (Merriam & Tisdell, 2015, p. 26). Due to the relatively limited amount of research on science education in both case study settings (Ha'apai/Tonga and Port Vila/Vanuatu), I found that qualitative inquiry also held the potential to make space for the inclusion of new and diverse voices in the field of science education research.

As Linda Tuhiwai Smith (1999) has suggested, research has often resembled "an encounter between the West and the Other" (p. 8). This, in turn, has consequently necessitated an "alliance with the critical strands of qualitative research and its practitioners" (Denzin & Lincoln, 2008, p. 3). Throughout this project, I have accordingly drawn on multiple qualitative research approaches in ways that support my sense-making process as an Indigenous researcher in a western academic discipline. In some respects, this experience reminds me of Durie (2004, p.9), who in the context of Aotearoa New Zealand, supported a similar notion of "research at the interface" between Māori (Indigenous) knowledge and Pākehā (European/western) scientific knowledge. He too asserted that such an interface can be "a source of inventiveness" (Durie 2004, p 9).

I subsequently wish to acknowledge Durie (2004) for reminding me that most Indigenous people live at the interface of multiple worldviews and that we make decisions every day in response to dilemmas. These dilemmas require us to carefully juggle assumptions, processes and products of these often-clashing worldviews and to determine their suitability when applied to the everyday challenges and contexts Indigenous peoples of the Pacific face. As a result, I have strategically employed qualitative approaches for their utility and relevance to various aspects of my study, while not limiting my interpretation to the tenets of one approach.

The global climate crisis is not experienced in isolation, but it is a shared reality across the Pacific. This influenced my selection of the opening proverb, Pikipiki hama kae vaevae manava (see translation at start of this chapter) to metaphorically guide the design and development of this doctoral study. At the conceptualisation stage, I metaphorically likened science education in Tonga to an outrigger canoe, which might benefit from drawing close to another canoe (Vanuatu) at sea, to share experiences and life-giving ideas. I believed valuable lessons could be learned from comparing findings of qualitative research conducted in schools located in both case study sites which faced comparable environmental challenges. Before commencing my journey across the Pacific Ocean to Port Vila, however, I had to also acknowledge the possibility implicit cultural biases as a researcher. I believed that researching science education in another Pacific nation may help me see my own context in Tonga more critically.

Hence, I chose to adopt a case study approach, in both my ancestral home of Ha'apai in Tonga as well as a neighbouring Pacific community, Port Vila in Vanuatu. As a Tongan teacher-researcher, I used the Talanoa Research Methodology to build relationships with participants in Ha'apai and Port Vila. As described in greater depth, later in Chapter 3), talanoa

is commonly described as a Pacific research methodology which is based on existing cultural conversational practice (Fa‘avae et al., 2016). A Tongan researcher (Vaioleti, 2013), has earlier proposed that talanoa is a “culturally appropriate means through which Pacific peoples can describe their own experiences in research”. Despite this claim, I still felt I needed to be cautious and acknowledge the cultural and linguistic heterogeneity of the people of Vanuatu and the wider Pacific region. As a result, I took a critical approach that was not dissimilar to Fa‘avae (2019), when deconstructing and reconstructing the guiding values and principles of talanoa when conducting research in the context of Port Vila, Vanuatu.

Here, I benefitted from adopting an autoethnographic approach which pushes researchers to “embrace an approach to writing which favours emotional self-reflexivity as a rich data source” (Chang et al., 2013). This approach is appropriate for writing about complex socio-ecological issues negatively impacting communities in Tonga and Vanuatu. As a result of employing an autoethnographic approach across two case studies, my assumptions about schooling, culture and the environment were radically challenged as discussed throughout this thesis.

Chapter by chapter thesis structure

Following this introductory chapter, Chapter 2 comprises a literature review that is relevant to my research aims. This chapter essentially raises questions about whose environmental knowledge ‘counts’. It highlights the marginalisation of Indigenous knowledge systems, particularly TEK from schooling systems found within Tonga, Vanuatu and other Indigenous peoples’ communities. This discussion then evaluates how climate change is taught in schools in Tonga and Vanuatu, whilst there are growing calls for Education for Sustainable Development in the Pacific. Finally, literature addressing science curriculum developments in Tonga and Vanuatu is reviewed to highlight how issues of language and foreign aid inform the curriculum development process in both case study sites.

Chapter 3 then outlines procedures used to collect qualitative data in Ha‘apai and Port Vila, to address my two overarching research questions. Here, I will provide more depth to my rationale for employing an eclectic range of qualitative research methods. This chapter also includes a description of how I gained entry to the field. This will include my account of conducting classroom observations, document collection procedures and those ethical considerations that guided this research. Special attention is given to my positionality and cultural values which in turn influenced how the research was carried out within each case study site.

Chapter 4 is intended to provide a contextual backdrop to the case study findings and is divided into two parts. Part One describes the context of Ha‘apai, an island group in the Kingdom of Tonga, in terms of schooling and local environmental issues. Part Two describes schooling and local environmental issues in Port Vila, a metropolitan city on the island of Efate in the Republic of Vanuatu.

The first case study chapter (5) then explores how local environmental issues are framed in Year 10 (locally known as Form 4) science classes in Heilala College (pseudonym) in Ha‘apai, a rural setting in Tonga. The three themes that arose from my thematic analysis of their responses form the structure of that discussion and include: (i) learning about the environment is situated (ii) a sense of place in relation to teaching and learning science and (iii) teacher learning. Chapter 6 next discusses how Ha‘apai Year 10 students conceptualised local environmental issues. This discussion is similarly based on findings which emerged from my thematic analysis of talanoa sessions with these student participants. The themes central to this discussion include: (i) the link between social and environmental realities; (ii) knowing the fonua and, (iii) obligations to the fonua.

Chapter 7 then takes the reader on a journey across the Moana to Port Vila, to begin the second case study. This chapter considers how local environmental issues are framed by Port Vila teachers of science. Similar to case study One (Chapter 5), this chapter presents the analysis of recurring themes from talanoa with teachers in Port Vila. These include: the opportunities of place and culture; (ii) the pressure of examinations and, (iii) the creative use of stories promotes student engagement. Chapter 8 explores how Year 10 students conceptualise local environmental issues in Port Vila, Vanuatu. The recurring themes central to the analysis passage of this chapter include: (i) Vanuatu’s changing environment and culture; (ii) the permeable classroom in the Pacific and, (iii) a case for Place-Based Education in Vanuatu.

Chapter 9 provides a synthesis of my analyses of the findings outlined in the four preceding chapters. The first section of Chapter 9 (Part One) analyses a series of four recurring/overlapping themes that emerged in the Ha‘apai and Port Vila case studies. These themes centre on place, language, culture and pedagogy in science education. Part Two then discusses those unique contextual realities I encountered in both of the case study sites which shaped the findings of each talanoa conducted in conjunction with this study. Part Three summarises some of the implications this research may hold for science education in Tonga and Vanuatu, as well as the Pacific region. This summary is based on my analyses of the research findings and my reviews of local, national and international literature.

To conclude, Chapter 10 will commence with a description of challenges I faced during this research. This description of challenges is followed by a summary of my key findings (organised within the four themes presented in Chapter 9) in response to the two research questions that propelled my research journey across the Pacific Ocean. Here, I will reiterate the key lessons I have learnt from that journey and how I believe it may contribute to the field of science education.

Chapter 2 : Literature Review

Introduction

As stated in Chapter 1, this study was designed to explore *how* Year 10 science students in Haʻapai (Tonga) and Port Vila (Vanuatu) conceptualise local environmental issues, and how their science teachers frame these issues. Haʻapai and Port Vila were selected as my case study sites due to the significant impacts of climate change on their communities after Category 5 TCs. The first of these, TC Ian, struck Haʻapai in 2014. TC Pam later struck Port Vila in 2015. Given that "our academic education is not culture-free" (Thaman, 2003, p. 7), this literature review provides a backdrop for this research by paying particular attention to the Pacific region. It revolves around the four themes pertinent to the research questions underpinning this thesis:

1. Learning about the World: Whose knowledge counts?
2. Traditional Ecological Knowledge in Schooling;
3. Climate Change and Pedagogy in the Pacific Region;
4. Curricular Context in Tonga and Vanuatu.

These themes, above, have been selected to provide a relevant structure that allows me to interrogate taken-for-granted assumptions that science educators, including myself, may possess about science education. Hence, this literature review questions the culture of schooling in my homeland (Tonga) and Vanuatu, particularly its relevance to the lived world experiences of Year 10 science students who possess Traditional Ecological Knowledge (TEK) that is Indigenous to the places they are from. As McKinley and Smith (2019) might suggest, my research aligns with other pieces of Indigenous education research in that it seeks to question:

> What [knowledge] counts, what matters, and how each dimension is defined. For example, Indigenous worldviews value the interconnected relationships of humans within the environment, and so, how does that worldview imagine an education, pedagogically, in curricula, assessment, and teacher education? (p. 6)

Learning about the world: Whose knowledge counts?

To make sense of the world around us, human cultures have developed various forms of science. Indigenous science is described by Cajete (2020) as "that body of traditional environmental and cultural knowledge unique to a group of people which has served to sustain that people through generations of living within a distinct bioregion" (p 1). Later Cajete (2020) acknowledges this view may pose various tensions for teachers of science, operating in the rigid confines of officially sanctioned curriculum frameworks:

> Culturally responsive sustainability education for Indigenous peoples also requires the inclusion of Indigenous knowledge on an equal par with modern Western science. This is a relatively new and radical idea for Western science and education which has been met with much debate. Proponents of inclusion of Indigenous Science argue that all cultures have developed a form of Science which is important to the overall diversity of human knowledge related to the biosphere. However, for some, only Western science is "true science" and all other forms of knowledge must be subordinate. (p. 3)

Hence, Cajete draws attention to the work of Barnhardt and Kawagley, who observed that while the tools of western science have alerted us to a changing climate, "the depth of Indigenous knowledge rooted in the long inhabitation of a place offers lessons that can benefit everyone, from educator to scientist, as we search for a more satisfying and sustainable way to live on this planet" (Barnhardt & Oscar Kawagley, 2005, p. 9).

Hence, I wish to explore the forms of knowledge considered by the participants in this research as being worthy of inclusion in the settings of Haʻapai (Tonga) and Port Vila (Vanuatu). In adopting this position I recall the work of Konai Helu Thaman (1992b) , who emphasised that a key question for Pacific educators to address is "how best to reflect their traditional education practices through the imposed structure of the school so that people are able to survive in a modern world and retain their cultural identities" (p. 3).

Her concern appears to be a recurring theme to emerge from my review of the education literature in the Pacific Islands. Beumelburg (2016), for example, suggested the Cook Islands schooling system has been influenced by a desire to modernise while also strengthening cultural identity. The *Tonga Education Policy Framework (2004 – 2019)* (Catherwood et al., 2004) stated that education "should help us find the right balance between the needs of the individual, the transmission of Tongan culture, and meeting the development needs of Tongan society" (p. 13). Elsewhere, my review of the academic and policy literature suggests that schooling in Vanuatu is presented with the dual functions of cultural preservation and enabling everyone to "contribute to the overall development of Vanuatu" (Vanuatu Ministry of Education and Training, 2020c, p. vii).

What strategies have been used regionally to incorporate Indigenous culture into schooling elsewhere in the Pacific region? It is telling that the *Pacific Culture and Education Strategy (2010 – 2015)* advised to key stakeholders that:

> Culture is transmitted through education. In the Pacific, the emphasis was formerly on Western cultures, but this has changed, and education generally now emphasises Indigenous culture. Improvements can be realised by involving families, through policies to integrate local languages and handicrafts, and through an emphasis on informal education. Approaches that could be useful include passing policies and

> legislation to make Indigenous languages official, and including these languages in school curricula (Council of Pacific Arts and Culture and Secretariat of the Pacific Community (SPC), 2010, p. 5).

If there is minimal cultural continuity between the Pacific communities where students are from and their schools (Sanga, 2000 as cited in Thaman, 2009), one is left to ask why and how this state of affairs has arisen and what are the potential long-term implications of this imposition of epistemological and ontological imperialism?

Research has highlighted the link between specialised knowledge of ecosystems and "local languages, through which this knowledge was encoded and transmitted, would in turn have become molded by and specifically adapted to their socioecological environments" (Maffi, 2005, p. 605). Elaborating on this link further, in *Biocultural Diversity Conservation*, Woodley (2010) linked changes in a culture with changes in biodiversity.

> Changing livelihoods, worldviews and value systems alter people's sense of place and cultural identity and lead to a breakdown in the intergenerational transmission of local knowledge, practices and languages that are so closely tied to the surrounding environment. In turn, this has a negative impact not only on cultures and cultural diversity, but also on biodiversity. (p. 133)

Skutnabb-Kangas (2013) argued that due to promotion of subtractive language education, "most of the world's Indigenous languages will no longer be learned by children in 2100 or else they will already be completely extinct" (p. 114). She warned this would lead to the loss of local knowledge of ecosystems carried through Indigenous languages (see also Hough and Skutnabb-Kangas (2005)). Skutnabb-Kangas strongly opposed the spread of English-only education among Indigenous communities (like those of Ha'apai and Port Vila) by alerting her readers to the risks posed by globalisation and monolingual curricula guidelines.

The above literature proposed the need for Indigenous communities (such as those in Tonga and Vanuatu) to critically rethink any model of schooling that does not consider the knowledge of Indigenous students' families and communities but rather engages the student with a 'banking concept' of education as described by Paulo Freire (1970/2005). In this anti-dialogical model of schooling:

> The teacher [often a community outsider] talks about reality as if it were motionless, static, compartmentalized, and predictable. Or else he expounds on a topic completely alien to the existential experience of the students. His task is to "fill" the students with the contents of his narration — contents which are detached from reality, disconnected from the totality that engendered them and could give them significance. (p. 71)

Rather than engaging in inquiry with students through dialogue, the narrating teacher imposes a sanctioned (official) knowledge of the world upon students, who must strive to demonstrate they understand this officially approved knowledge to gain credentials that, in turn, will raise their social status. In response to this striving, Bourdieu coined the term *cultural capital* to explain "the unequal scholastic achievement of children originating from different social classes by relating academic success … to the distribution of cultural capital between the classes and class fractions" (Bourdieu, 2002, p. 282).

Cultural capital can thus be transmitted in an institutional culture such as that of officially sanctioned assessment procedures and the inequitable distribution of academic qualifications, which allows holders of credentials (and those without) to be compared when applying for jobs in the labour market (Bourdieu, 2002). In relation to the plight of young people living in Haʻapai and Port Vila, their experiences of secondary school science education are closely aligned with the qualifications frameworks that students elsewhere in the Pacific have experienced from New Zealand. As Tupeni Baba (1985) described:

> In terms of the content of education, government schools used the language of metropolitan powers, such as English, French and German as the medium of instruction and they also introduced foreign curricula and examinations. This is still the case in some of the independent countries of the South Pacific; the New Zealand School Certificate and the New Zealand University Entrance Examinations, which are taken at Forms 5 and 6 respectively, are still being taken by most of the secondary schools of the independent countries of the South Pacific ... As a result, schooling placed a lot of emphasis on academic and often irrelevant learning for the purpose of passing external examinations. (pp. 131 - 132)

With the gradual nationalisation of secondary school curriculum and assessment of some Pacific Island countries post-Independence (Rees, 1985; Tarosa, 2013; Vaka-Vivili, 2014), a focus has been retained on participation in the global economy, recognising the force of globalisation. Samu (2010) warned that globalisation has led to "the uncritical acceptance and use of terms such as the global economy, and the global market-place" (p. 4). For example the secondary school education policy issues highlighted in the *Tonga Education Policy Framework 2004 - 2019* (Catherwood et al., 2004) included "how to serve the needs of secondary school age children who may emigrate as adults, ensuring that they have the skills and competencies required in a global economy" (p. 31).

Similarly, the *Vanuatu National Curriculum Statement* (Vanuatu Ministry of Education, 2010a) asserts that "the mission of our schools is to teach and prepare students to act socially, economically and politically on behalf of our country and to be part of the global community" (p. 21). It appears that globalisation discourse may be a powerful determinant in

what knowledge and skills are included in national curricula, held in tension with local values. The tension is demonstrated in the assertion made by the Director General of Education in the *Vanuatu National Curriculum Statement*. "We acknowledge that we are part of a global community but this document also makes it clear that we need to be self-reliant and must develop a curriculum relevant to Vanuatu, based on values derived from Vanuatu's cultures and beliefs" (Vanuatu Ministry of Education, 2010a, p. iii). This research pays particular attention to how the tensions between the global and the local interact in teaching local environmental issues in science classes in specific Pacific communities.

The marginalisation of local cultures, languages and customs in schooling sends subliminal messages to the learners and their communities. For example, in Fiji, Varani-Norton (2017) wrote about the effects of this on the iTaukei (Indigenous Fijians):

> While outside the classroom culture preservation is encouraged, inside the classroom the superiority of European knowledge and values is emphasised. IK [Indigenous Knowledge] is always historically viewed by the colonialists as inferior and backward; this view has "rubbed off" on iTaukei themselves, wittingly or unwittingly. To redress this mindset should be a major educational challenge. (p. 132 - 133)

This suggests the concept of hidden curriculum described by Snyder where it is not the formal curriculum but the hidden curriculum that "determines, to a significant degree, what becomes the basis for all participants' sense of worth and self-esteem" (Snyder, 1971 as cited in Hansson, 2018, p. 297). For example, students tend to associate science with what has been communicated to them through science classes, which can be very narrow so that students do not explore other perspectives from which science can be understood (Hansson, 2018). However, teachers can recognise the science embedded in the local culture through looking at traditionally made items and asking "what science do people have to know and understand in order to make and use these objects?" (Adams, 2010, p. 332).

When theorising this oppressive state of affairs Bourdieu refers to successes in a nation's examinations system as indicators of 'cultural capital, inherited or acquired' (Bourdieu, 1988, pp. 230 - 232; as cited in Jenkins, 1992, p. 74). Examinations signify what forms of cultural capital are valued by a schooling system. Bourdieu's theorising appears to hold merit when one considers the extent to which national examinations can pose problems for Pacific Island governments and, inevitably, the communities they purport to serve because as Bray (1992) explained:

> Examination systems are powerful determinants of the actual curriculum in schools. It is not always easy for the governments of small countries to decide whether to set their own examinations or whether to use those of foreign countries. The main

> advantage of operating domestic examinations is that the assessments can be designed to support the authorities' curriculum priorities. This may include examinations in local languages, and about local economics, geography, history, etc. The main disadvantages of operating domestic examinations are that small countries … may find that the qualifications are not recognised outside the country, and therefore that citizens encounter difficulty either gaining employment or proceeding to further studies abroad (p. 72).

In Tonga, it has been well documented that secondary school examinations have been influenced by the New Zealand and Australia schooling systems. For example, Tongan Government secondary school students were required to sit the *New Zealand School Certificate* examinations in Year 11, until the development of the national *Tonga School Certificate* (Palefau, 2005). In Vanuatu, following independence from the joint colonial rule of British and French governments, Year 11 students in English-speaking schools continued to sit the English school system's *General Certificate of Secondary Education* (Tarosa, 2013). Later, the *Pacific Secondary School Certificate* would be developed and adopted by both Tonga and Vanuatu as part of efforts to "break away from externally-driven syllabi and examinations" (Mather, 1997, p. 43).

It is also worth noting that examinations become necessary in those 'banking' models of education (as described by Freire 1970/2005), whenever students must memorise and regurgitate the deposits of knowledge previously invested in them by their teacher. Thus, Freire (1970/2005) contends that:

> The capability of banking education to minimize or annul the students' creative power and to stimulate their credulity serves the interests of the oppressors, who care neither to have the world revealed nor to see it transformed. The oppressors use their "humanitarianism" to preserve a profitable situation. (p. 73).

The effect of the banking model on teachers can also stifle their creativity. In Tonga, for example, 'Otunuku et al. (2017) suggest that the culture of assessment leads to pedagogy no longer being innovative but prescriptive. Literature suggests that Indigenous knowledge is place-specific, and therefore would be undervalued by education modelled after foreign examination systems. In the context of Tonga, Thaman (2003) has argued that "decolonising formal education involves accepting Indigenous and alternative ways of seeing the world" (p. 10).

As a source of Indigenous knowledge, TEK recognises the links between people and their environment and has been defined as "cumulative environmental knowledge, belief, and practice of local and Indigenous people" (Berkes, 2012 as cited in McCarter & Gavin, 2014, p. 288). Writing from a Native American perspective, Cajete (2020) helpfully reminds us that

"the use of traditional ecological knowledge in a balanced relationship with other forms of knowledge to address the challenges of climate change is an essential activity" (p.5).

Given the challenges of environmental degradation that threaten the liveability of our places in the Pacific region, studying TEK in Pacific Islands' schools requires serious consideration. Cultures of assessment should also be carefully reconsidered given the manner in which TEK has long been excluded from science curriculum guidelines and summative assessment procedures. In Tonga, Koloto (1998) explained that this began with the establishment of the early mission schools (1820 - 1860).

> The curriculum of the missionary schools represented the knowledge that missionaries considered to be important and of value … This period saw the beginning of the undervaluing of traditional knowledge and skills. As with other nations of the Pacific, traditional knowledge possessed by the local people before contact with Europeans was not included in what was taught in schools, so that traditional knowledge was replaced over time with the technological knowledge of the West (Helu Thaman, 1995; Mara et al., 1994). (Koloto, 1998, p. 124)

Palefau (2005) raised concerns over the continued exclusion of traditional knowledge and skills (TKS) in the Tongan curriculum (or what I refer to elsewhere in this thesis as TEK). He highlighted that one of the aims of secondary school science education in Tonga was to "encourage an appreciation of the role science plays in Tongan life, in particular, the need for a scientifically literate community and the maintenance of industrial and natural resources." (Tonga Ministry of Education, 2000 as cited in Palefau, 2005, p. 55). However, this was not reflected in the rest of the curriculum. Furthermore, elders who were traditional knowledge holders were concerned that traditional knowledge pertaining to fishing and agriculture and other areas would be lost unless they were included in school curricula.

In Vanuatu, McCarter (2012) described the impacts of foreign influences on Vanuatu education even post-independence:

> First, it removes children from the traditional learning context at an early age: at primary school, children are expected to attend for at least 30 hours per week, and at secondary level they commonly board at the schools … Third, in maintaining a centralised curriculum based on New Zealand and Australian models and subjects (such as Science, English/French, and Maths), it ignores and devalues the diversity of indigenous knowledge and practice throughout the country. (p. 83)

The above factors may disrupt the intergenerational transmission of TEK in Vanuatu. Efforts to teach TEK in primary schools faced challenges when the Vanuatu Ministry of Education decided to review all school curricula, requiring changes to be made to the teacher guidebooks

which were created to be used to teach TEK alongside the previous science curriculum (McCarter et al., 2014).

When one considers the lack of synergy that can exist between the knowledge that is assessed by teachers in science classrooms and students' home environments, much literature suggests that students can best be supported to cross the cultural divide by experiencing contextualised curricula (Tapia, 2020). This stance ultimately suggests that science teachers (and official curriculum planners), finally recognise that science and school science have particular norms and values shared by the science community members (such as scientists and science teachers) which can mean that school science is taught in ways that are disconnected from students' everyday lives (Aikenhead, 1996).

Lemke (2001) suggests that it is imperative that we view "Science Education, and research on science education as human social activities conducted within institutional and cultural frameworks" (p. 296). Given that the Tongan Ministry of Education and Training has expressed concern that many students are not choosing to enrol in science subjects in secondary schools, this research may be timely in making a contribution to official reconsideration of science as taught in my nation's secondary schools (Matangitonga, 2020a). At the very least, it may prompt some careful reconsideration of the status of TEK in Tonga's secondary schools.

Traditional ecological knowledge in schooling

In the context of Vanuatu, TEK, has been translated into Bislama, with the assistance of the *Vanuatu Cultural Center*, as "kastom save blong envaeromen" (McCarter & Gavin, 2014, p. 290). It is also worth noting that Bolton (1999) proposed that the origin of the term may be in the distinction that Christian missionaries tried to make between practices perceived to be heathen and acceptable Christian practices. Kastom, however, has been represented in various ways in contemporary society and was notably repositioned alongside Christianity during the political struggle for independence to unite the country (Bolton, 1999; Forsyth, 2009). Lind (2016) described the transforming relationship between Christianity and kastom:

> Despite missionaries' efforts to oppose Christianity and *kastom*, in a bid to save islanders from a 'dark' past, Vanuatu's first government found the need to transform this relation, encouraging ni-Vanuatu to understand Christianity and kastom's differences as mutually expressive of their nation's contemporary needs, its particular character and its capacity to engage internationally. In such terms, the pair appears neither essentially opposed nor complimentary; rather, it is their 'differences' that allow them to respond fluidly to changing circumstances. (p. 232)

As a result, science education was introduced to Vanuatu in the context of skul (Bislama for school/schooling), which Bolton (1999) described as "the antithesis of kastom" (p. 341).

My study, consequently, explores how school science is learnt by students in relation to kastom in contemporary Vanuatu schooling. Indigenous knowledge in Vanuatu's marine ecology, for example, can be represented in relation to issues of resource management. Hickey (2006), for example, has written about the adherence to the imposition of a taboo on gardening activities when having recently consumed certain marine species or visited the sea:

> In areas such as Futuna, Tanna, Aniwa, Paama and Ambrym Islands, the consumption of nearshore resources is considered to be taboo from the time yam gardens are initiated until the New Yam Ceremony some six months later. This would ensure a good harvest of seafood for New Yam celebrations as well as during the subsequent months of ongoing yam harvesting. As this summer closure coincides with the time when most nearshore fish and invertebrates are believed to be at their spawning peaks, the annual half-year taboo serves to protect resources during this vulnerable period (p. 17).

Regenvanu (2005), likewise, argued that traditional sustainable resource management practices are part of Vanuatu's traditional economy and have sustained its rich natural resource base (such as forests and coastal areas). This differs to conservation views rooted in western philosophies – which see humans as separate and thus needing to be removed from nature. This western philosophy therefore differs to an Indigenous worldview of nature in Vanuatu where many Indigenous people still believe that "ecosystems and social systems are intertwined" (United Nations Educational, Scientific and Cultural Organisation (UNESCO), 2017b, p. 38). When contemplating these clashing worldviews, one must also consider the role of history.

Villagers of Tongoa Island (Vanuatu), for example, have long claimed that the transmission of kastom (knowledge) occurs via the pedagogies of "oral history and learning by doing" (Granderson, 2017a, p. 551). These pedagogies were intentionally disrupted by children's entry into western (colonial) schooling systems. Today, the VCC is actively involved in efforts to revitalise and maintain kastom. It has worked collaboratively with the UNESCO Local, and Indigenous Knowledge Systems group, to develop curriculum modules for teaching TEK in schools. This work has consequently resulted in increasing teacher/student contact with community experts (McCarter, 2012).

Elsewhere, Bolton (2003) has described kastom as a phrase "that people in Vanuatu use to characterise their own knowledge and practice in distinction to everything they identify as having come from outside their place" (p. xiii). However, kastom has place-based meanings and in the urban centres of Luganville and Port Vila "kastom refers to aspects of culture and tradition that are often disconnected from localised practices" (Shipman, 2008, p. 8). In rural

areas, livelihood strategies are not static, and people continue to adapt them after Category 5 TC Pam (Hetzel & Pascht, 2019).

Given the dynamic nature and diverse forms of TEK, plus the cultural and linguistic diversity found in urban Port Vila/Vanuatu schools, one must consider the challenges facing science teachers in seeking to engage kastom knowledge about the environment. In these urban centres, it is possible that the students and teachers may (or may not) identify with different "home islands" (Kraemer, 2013, p. 24). Thus, the question often arises, whose kastom knowledge would be represented and whose would be left out in the design of this science education programme? As DeBlock (2018) therefore suggests, the incorporation of kastom may hold the potential to divide as conflicts can arise over who has the right to certain practices in efforts to revive kastom through festivals or tourism interactions.

Since a large percentage of secondary schools in Vanuatu, as well as Tonga, are run by Christian churches (Catherwood et al., 2004; Vanuatu Ministry of Education and Training, 2020b), science teachers need to consider how their students engage with Indigenous knowledge, Christianity and climate-change science in school settings. While Christian religious beliefs in Vanuatu are heterogeneous in nature and hold the potential for apathy or fatalism to exist, these beliefs also hold the potential to be compatible with climate action, and of interacting with science in different ways (Fair, 2019).

However, challenges to incorporating TEK into school curricula in Vanuatu reported by McCarter et al., (2014) included opposition from evangelical Christian groups, who may have perceived this as risking an increase in sorcery. Another challenge is that unlike western science, some TEK is gendered such as male sacred musical instruments in Vanuatu (McCarter et al., 2014) and the gathering of marine seaweed and invertebrates by women known as fangota in Tonga (Malm, 2009)).

This research considers how students may engage with these concepts while acknowledging that the understandings of these concepts may overlap and evolve in local contexts. For example, Flexner (2016) challenged the dominant narrative of cultural conversion in Vanuatu and demonstrated "a material process by which Christianity became Melanesian in the first nine decades of missionary endeavours on Tanna and Erromango" (p. 159). The work to contextualise education must also be recognised along a parallel process of contextualising another missionary endeavour, theology in regional institutions such as the Pacific Theological College in Fiji (Nabobo-Baba, 2013). However, real tensions do exist between these concepts, such as between western science and Indigenous Knowledge as demonstrated by the patenting of Pacific traditional crops, such as kava and taro, as described by Ratuva (2009):

> The Pacific is home to some of the most diverse life forms, languages and culture. This has attracted scientists working for large food and pharmaceutical corporations interested in extracting not only traditional knowledge, but also the actual natural material to be patented. A large number of well-known Pacific species have been patented. This is a case of western science, driven by corporate interests, being utilised to extract and pirate traditional knowledge (p. 157).

Tongan TEK is underpinned by values of reciprocity and communal living and fulfilment of societal obligations. However, not all practices are sustainable. For example, in the past, the practice of subsistence shifting cultivation where farmers moved to a new plot of land every year exhausted forest resources (Pole, 2014). Other traditional practices may promote the planting of culturally significant plants. For example, the ngatu (tapa cloth) produced by Tongan women and used in cultural exchanges today are produced from the traditional processing and printing of the bark of hiapo (paper mulberry) trees – using plant-based dyes (Fielakepa, 2014). This practice thus relies on the supply (and thus planting) of hiapo (*Broussonetia papyrifera*) trees required for this production, plus the varieties of tongo (*Rhizophora mangle*), tuitui (*Aleurites mollucana*) and koka (*Bischofia javanica*) used for dyes (Tonga Department of Environment, 2004, p. 114).

The threatened status of mahoa‘a Tonga (*Tacca leonopetaloides*), meanwhile, has led to its replacement by other forms of glue in the Tongan ngatu (tapa cloth) production process in which strips of beaten hiapo bark are pasted together (Tonga Department of Environment, 2004). Interestingly, mahoa‘a Tonga was also traditionally “used as a source of food during food shortages by extracting starch from the tubers” (Tonga Department of Environment, 2004, p. 22). This reflects the multiple applications of various plants evident in the TEK of Tonga, including other plants such as toa (*Casuarina equisetifolia*) which is used both for timber (Tonga Department of Environment, 2004), and traditional medicine (Croft & Tu‘ipulotu, 1980).

In November 2020, it was also interesting to read a *Matangitonga* (online) news story, produced by Eleanor Gee, which featured a story about a workshop in which participants learned to use “a mixture of traditional and modern materials to build the fale-Tonga that is more weather friendly than an enclosed tent, especially when it is hot and humid” (Gee, 2020, para. 5). This workshop took place as part of the *Disaster Resilience for Pacific Small Island Developing States* project and can be taken as an example of how traditional knowledge is being promoted as a measure of building resilience in communities in Tonga. Palefau (2005) referred to these construction skills, as part of Tonga’s Traditional Scientific and Technological Literacy (TSTL) concept, which his research defined to mean “Indigenous peoples’ skills and

knowledge that have been used, experimented with, tested by trial and error and through hardship, in order for them to survive in the place they live" (Palefau, 2005, p. 166). Some of the other TSTL he identified through his research, with elders, included food production, navigation, music and dancing, and translated the TSTL concept into Tongan as "Ko e talatukufakaholo ʻo e ʻilo ʻo e saienisi mo e tekinolosia" (p. 484).

The concept of talatukufakaholo, similarly, implies the passing down of knowledge in oral form, from one generation to another, in the context of a relationship between a parent and her/his child (Lātū, 2017). Palefau (2005), however, also highlighted the loss of opportunity to put this TKS into practice. In the Tongan science syllabus there are potential curricula areas in which to integrate TKS, which can be simplified with a learning outcome that can be achieved through writing. For example, the Year 10 unit 10.1: *Living World* in the *Science Syllabus for Secondary Schools in Tonga* (Tonga Ministry of Education and Training, 2015) states that students should know "Existing feeding relationships in local communities and ecosystems" (p. 32) but only requires students to "discuss … different feeding relationships existing amongst living things in the community in Tonga" (p. 32).

With regards to navigating vast stretches of the Moana (ocean) using time-tested skills such as the keen observation of sun, moon, star positions; notable seamarks and landmarks, plus maritime creatures, Palefau (2005) argued that "while this knowledge can be explained by words, it is better learned via apprenticeship, like the other TKS. At present, the school curriculum has no curriculum materials and provides no experience in this area of TKS" (p. 306). This argument, rightly, emphasises the need for authentic learning and assessment tasks that occur in real-world settings rather than in dusty classrooms that are far removed from the authentic contexts 'where' this knowledge must be applied. I am therefore, also inclined to agree with Palefau (2005) when he rightly explained concern that:

> The myths and types of shallow water fishing are included in the Form 2 (Grade 8) Science curriculum, but students are not given any direct practice, despite the tradition of learning by doing as the way to enhance understanding and current learning theories" (p. 300).

Palefau's concerns (above) would also suggest that any efforts to introduce traditional Tongan knowledge and skills to the local science curriculum must include careful consideration of changes in pedagogy to ensure any prospect of a successful change in science curricula content. A promising pedagogical approach is widely known as Place-Based Education (PBE) and it has worked to incorporate traditional or Indigenous science into science education in secondary schools. For example, in Alaska the *Spiral Pathway for Integrating Rural Alaska*

Learning (SPIRAL), a culturally-oriented framework with a "place-based curriculum structure" (Barnhardt, 2007, p. 123), was developed, which enabled students to learn Indigenous knowledge associated with fisheries, trapping and subsistence way of life, among many other customs.

However, Calderon (2014) was critical of place-based education in the USA which "fails to meaningfully engage colonial legacies in education and particularly how conceptions of place have been involved in their continuance" (p. 25). Generally speaking, PBE involves an eclectic approach to the design, delivery, assessment and evaluation of culturally responsive curriculum that draws from, "… experiential learning, contextual learning, problem-based learning, constructivism, outdoor education, Indigenous education … as well as other approaches that are concerned with the value of learning from and nurturing specific places, communities or regions" (Gruenewald, 2003a, p. 3).

Advocates of PBE therefore emphasise that it is important to recognise the importance of local environments to the learning process. Such holistic thinking, however, is not new to Pacific academics. For example, Thaman (1998a) offered this opposition regarding the urgent need to contextualise tertiary education courses in the Pacific:

> Recent advances in ethnoscience, ethnobiology, ethnomathematics and folk taxonomy are increasingly becoming important and have much to offer course writers and developers, particularly in the sciences and mathematics, and the use of field-based studies in the social sciences will enhance not only course relevance but students' own knowledge of the local environment. Moreover, using their own environments and societies as 'living laboratories' can also serve to create greater and more equitable access to these important 'educational facilities' (Thaman 1997). (Thaman, 1998a, p. 15).

Hence, at differing stages of this thesis I will discuss PBE as offering one way to "reconnect education to a sense of place and its attendant cultural practices and manifestations" (Barnhardt & Oscar Kawagley, 2005, p. 10) by giving examples of how it has been implemented within science education in specific communities relevant to those of my two case study settings in Haʻapai (Tonga) and Port Vila (Vanuatu). For now, it will suffice for me to give an example of a small rural Alaska school. Almost all of that school's student body was comprised of (Indigenous) Yup'ik children, and a place-based programme was subsequently implemented in 2002, so they could see themselves and their world reflected in that school's curriculum (Takano et al., 2009).

This PBE program, involving both community members and the school staff and students, recognised the limited employment opportunities in the community and the need for

students to retain subsistence skills that would help them connect with their environment and survive there. The place-based learning activities that students encountered could, moreover, be linked to multiple curriculum areas (Takano et al., 2009). For example, berry picking is a traditional Yu'pik activity. Thus, students were taught to do this by using expert local elders' (historical) knowledge of the traditional places to harvest berries. A dichotomous key would also be used to identify local plant species and students needed to complete writing assessments about this activity and create a PowerPoint presentation.

The practical subsistence activities, for junior high school students, therefore involved learning knowledge and hands-on skills they could apply in other aspects of their village life:

> It was clear from observation that one activity must be looked at in relation to the entire process, and it involved various levels of learning and experiences. For example, manaqing (ice fishing) started with making a fishing tool, dressing up according to the weather and the forecast, getting other gear ready, getting to a specific place, knowing where and how to make a hole and how to treat the fish once they were caught. (Takano et al., 2009. p. 354)

The positive impacts on the community included student involvement in rebuilding the community connection to the school and this was an important step given the negative legacies of previous assimilation policies. The local Yu'pik community appreciated that their values of subsistence living were being taught to the youth. The youth themselves reported having a stronger connection to the land and their families noted their children's academic skills had improved in correlation with the students now enjoying their schooling (Takano et al., 2009). Through studying the Indigenous science central to the traditional subsistence skills relevant to their community, the students became increasingly more aware of how their village life depended on the health of the environment. In the year after the program was implemented, most students' families also reported eating more subsistence foods, relying less on (unhealthy and expensive) external sources.

The work of Takano et al., (2009) draws attention to the potential of PBE approaches to be applied in ways that strategically seek to incorporate subsistence activities, which my review of the literature also suggests may have some positive implications for Indigenous peoples' food sovereignty and planetary health across the Pacific region. For example, Indigenous food sovereignty movements can include setting up community gardens for growing native foods in both rural and urban settings, as demonstrated by the Ohlone peoples of California. The (global) Indigenous food sovereignty movement, however, employs place-conscious approaches to education to offer "much more than consumption choices, food access,

and traditional knowledge; it is fundamentally about [ensuring] access to land for sacred ceremony and traditional practice" (Wires & LaRose, 2019, p. 31).

Planetary health is another concept that allows deeper appreciation of Indigenous frameworks of health in the Pacific region, which are linked to the well-being of Indigenous peoples and their places of being. "As for many Indigenous peoples, land is both an environmental and cultural determinant of health" (Hond et al., 2019, p. 45). In Aotearoa New Zealand, for example, access to land and knowledge of how to use the land for traditional, sustainable and healthy food production has been an outcome of community gardens, known in Māori as māra:

> Māra produce nutritious food and so much more than is required to sustain healthy and vital Māori communities. Māra is in itself a metaphor, regenerating a living environment of social cohesion by working together, reconstituting a cultural substrate in which development aspirations and authentic identity can be cultivated and realised. These intangible fruits are nurtured in the norms and nuances of local communities. Garden settings are immersion domains of language, socialised values and self-determined solutions constructed and adapted within the consequences of colonisation, impoverishment and debilitating stereotypes. They resist a prevailing tide of cultural oppression, the orthodoxy of intensive farming and separation from the means of production. (Hond et al., 2019, p. 52)

When reflecting critically upon the global and regional PBE literature in relation to my experience as a student and teacher in Tonga, it dawned upon me that these discussions of the positive health, environmental and social outcomes arising from place-conscious actions (such as community gardens) are very relevant to the contexts of schooling in Haʻapai (Tonga) and Port Vila (Vanuatu). At the Tongan secondary school where I teach, vendors sell food such as imported instant noodles and hotdogs nearby and this contributes to various health problems. The plastic packaging of these food items also creates a litter problem.

It did not surprise me, furthermore, to discover that a study among primary school children in Haʻapai, found their diet was likely dominated by the presence of (western) energy-dense-nutrient-poor foods which they buy, showing its accessibility to the community (Veatupu et al., 2019). This study also made some telling recommendations as to 'how' schools in Tonga can combat the global non-communicable disease pandemic. The authors, amongst other things, claimed that:

> School could be a place for the promotion and provision of healthy food, including healthy traditional foods. This could occur through requiring only healthy food in schools, not allowing children to leave school at lunchtime and/or provision of food in schools, links to the school curriculum, and utilising school gardens (Puloka, Smith Chambers and Signal, 2017) … Finally, this study reinforces the need for a national

> conversation about actions to meet the challenge of NCDs [noncommunicable diseases], to avoid the consumption of EDNP [energy-dense-nutrient-poor] imported food, and place focus on the traditional diet based on fishing, farming, and gardening (Veatupu et al., 2019, p. 12).

PBE, additionally, aligns nicely with Social Constructivist theories, which can also be employed to draw attention to the nature of teaching and learning science in the case study settings of my research. A strategic combination of PBE and Social Constructivist theories, as the following chapters suggest, can help practitioners (i.e., science teachers) to evaluate how well Indigenous students in Haʻapai and Port Vila are being engaged with science education. Social Constructivism, after all, asserts that "learning is a social process, mediated by the learners' environment and … the prior or Indigenous knowledge of the learner is of significance in accomplishing the construction of meaning in a new situation" (Linn & Burbules, 1993, as cited in Jegede & Aikenhead, 1999, p. 45) .

Social constructivist teachers and researchers (like myself), therefore, emphasise the need for recognition of learning as a social process. The significance they place on 'prior knowledge' invites students (including Indigenous students) to share their prior knowledge in the classroom. As Freire (1970/2005) suggests, this reflects a 'dialogical' approach that has the potential to be transformative, especially when compared to the banking concept of education:

> In the banking concept of education, knowledge is a gift bestowed by those who consider themselves knowledgeable upon those whom they consider to know nothing. Projecting an absolute ignorance onto others, a characteristic of the ideology of oppression, negates education and knowledge as processes of inquiry. (p.72)

This approach also resonates with the work of two Māori academics (Elizabeth Ann McKinley & Linda Tuhiwai Smith, 2019) who, similarly, assert that Indigenous peoples' relationship to earth comes with "diverse and relational paradigms of knowing and being" (p. 3). From my review of the literature, I would contend that numerous possibilities exist for enhancing Indigenous student engagement in science, when science teachers and curriculum writers recognise the existing knowledge that sits in their communities.

To ignore the value of this (prior or Indigenous) knowledge of place can only have negative social effects. For example, one only need to critique the negative impact that colonial/neo-colonial cultures of testing have had on youth residing in places like Haʻapai and Port Vila. As Tongan scholar Konai Helu Thaman (2003) has strongly argued:

> Western educational legacies, their philosophies, ideologies, and pedagogies, which for nearly 200 years have not fully recognised the way Oceanic peoples communicate, think, and learn — ideologies that sought to destroy the values and belief systems

> underpinning indigenous education systems in which the majority of Oceanic peoples were and continue to be socialized. (p. 2)

Earlier, Thaman (1992b) suggested teachers across the Pacific region should look more towards their own (Indigenous) cultures for learning solutions, taking note of how learning may occur in traditional settings, including "learning by doing rather than learning from talk and demonstration. Learning in real-life situations rather than from abstractions" (p. 11). These traditional ways of learning, and the disruptions to them, are useful in considering how best to raise levels of student engagement with science. In Tonga, the concept of ako means a lifelong process to gain knowledge ('ilo), and to become wise (poto). Thaman (1998b) adds that:

> *Ako* means to learn in a society where people are expected to behave in accordance with their various roles and status. Learning, before the introduction of schooling in the 1830s, was largely through observation, listening and imitating others, mainly adults who already had the knowledge, skills and values necessary for living and surviving in Tonga … *ako* has become closely associated with formal education and *poto* with the achievements of formal education. One who fails in school is referred to as *vale*, a term which implies not only a lack of useful knowledge but the inability to be of use to anyone. (pp. 73-74)

Indeed, failing school is a serious problem in Tonga with severe social consequences for students who do not achieve a passing grade. In 2019, only 27% of students who sat the Form 5 (Year 11) Tonga School Certificate passed (Matangitonga, 2020a). This, despite the research of Johansson-Fua et al. (2007) finding that Tongan parents also like to acknowledge their children's diverse talents and skills, such as weaving, performance and farming (which are not part of the school's curriculum). The fact that schooling in Tonga fails so many students had promted the establishment of a community school by the Wesleyan church. This school focuses on developing skills that are relevant to gaining a livelihood in Tonga, often underpinned by TEK, and Christian principles (M. Puloka, personal communication, December, 2019).

In Vanuatu, meanwhile, high participation in the traditional economy means that the 80% of the population who live in rural areas satisfy their needs through traditional means of utilising resources on land and sea (Regenvanu, 2010). This may lead to the assumption that children in Vanuatu have rich learning opportunities in these rural contexts. However, Regenvanu (2010) argues that Vanuatu schooling must be transformed for this to happen, claiming that:

> It is a sad fact that our basic education system is still largely premised on the colonial rationale of producing bureaucrats to run the state administration. Formal schooling at primary and secondary levels actively contributes to the loss of the knowledge and

> skills that allow an individual to function as a member of their own community and a part of the traditional economy. The ongoing loss of traditional knowledge and growing problems with marginalised youth are, I believe, a testament to the failure of our basic education system to provide a pathway to an appropriate and sustainable development which must have, at its base, a strong traditional economy. (p. 33)

Kraemer (2013), likewise, found that although parents had moved to Port Vila for a better life for their children, this had meant that many of the youth did not accquire the social knowledge needed for life in the outer islands. Furthermore, because of the cost of education and limited access to secondary schooling, many young people in Port Vila, have not completed schooling beyond class six. This came to my attention, for example, when Tarosa (2020) reported that "the success (or survival) rate to year thirteen has gradually increased from just 7.3% in 2011, to 23% in 2018" (p.15).

While I found a limited range of literature specifically addressing students' engagement with science education in secondary schools in Tonga and Vanuatu, other literature from around the region proved helpful in terms of illuminating wider regional trends that may reflect the realities of Tonga and Vanuatu. For example, research in Tonga suggested that questioning was not found to be a dominant practice. Drawing upon the anecdotal evidence of my own lived experiences (i.e., as a student and teacher), I would propose that student questions may often be "seen as questioning the authority of the elders, being parents, teachers and all those that are supposed to 'know' and are expected to tell others what to do" (Bay et al., 2016, p. 5).

Hence it was interesting to discover that research in a Papua New Guinea (PNG) Grade 9 science class (Najike, 2004) observed limited participation in the class as students were typically observed passively receiving knowledge from their teacher in a manner that recalls Freire's (1970/2005) description of the 'banking' model. This pattern of behaviour was attributed to how traditional knowledge is passed on in PNG, with Najike (2004) explaining that, "in the culture of the students and David [the classroom teacher], this was the acceptable approach of teaching where knowledge was transmitted from a source, usually a respected elder in the community to a source" (p. 232). Elsewhere, Tuafuti (2010) similarly suggested that for Pasifika students, "to listen and obey without question is the traditional dictum and to question an authority is a sign of disrespect and impoliteness" (p. 5).

The findings above consequently highlight the potential for tension to arise between traditional ideas about adult/youth dialogue and those cultural assumptions underpinning (western) social constructivist science education, which require students to co-construct knowledge rather than receive knowledge transmitted to them by adults. As Tapia (2020) has explained:

> Learning Science with understanding can be considered a generative process of constructing meaning from (1) our own knowledge and experiences in the world, (2) new incoming sensory information, and (3) shared cultural narratives … "prior knowledge and experience" is understood as the ways that we make sense of the world around us, which is a function of the cultural and historical context. (Tapia, 2020, p. 2)

It helped, eventually, to discover the work of Havea (2020), which found that teachers did not believe climate change was effectively addressed in the syllabus. Havea (2020) implemented a culturally responsive socio-constructivist teaching and learning intervention based on the Tongan practice of talanoa. Havea (2020) suggested that "climate change education would be more effective if the education providers identify the students' and teachers' current perceptions of the issue, and then design the education programs to address and build on these perceptions" (p. 286). This research, subsequently, explored these conceptualisations, considering a wide range of influences on students' conceptualisations of environmental issues (leaving this open to interpretation by participants) and teachers are prepared to engage with these. Through this research, I also explored how teachers in Haʻapai and Port Vila engaged with learning theories such as constructivism/social constructivism in their everyday practice and what they considered to be the effect on students' engagement with science in this era of climate change.

Climate change and pedagogy in the Pacific region

Before I discuss what students learn about climate change in schools in Vanuatu and Tonga, I would like to acknowledge, firstly, the home and community settings where TEK is passed on. Schooling in both countries can have a negative relationship with TEK. McCarter and Gavin (2011) found that in Malekula (Vanuatu) participants believed schooling drove TEK erosion through the promotion of new languages which came with new knowledge systems. In Tongoa (Vanuatu), for example, the erosion of kastom knowledge was linked to the participation in western schooling (Granderson, 2017b). Tongoa villagers also reported the application of kastom knowledge was also being confounded by climate change as their "established bioclimatic indicators are increasingly out of sync with their associated routines, including customary rituals, fishing, gathering of fruits and nuts, and planting and harvesting of crops" (Granderson, 2017b, p. 553).

In Tonga, Palefau (2005) similarly reported that although traditional fishing and navigational practices at sea continues, their popularity has decreased due largely to the availability of new technology. As a result, the elders participating in Palefau's study believed aspects of traditional Tongan scientific knowledge should be included in school curriculum.

TEK and scientific knowledge may influence students' understanding about climate change in different ways. Hetzel and Pascht (2017) found that compared to youth in rural areas, youth in Port Vila adopted a different way of knowing about the environment. They noted that:

> Whereas traditional knowledge is part of the environment of people living in rural areas, scientific knowledge is part of the daily life of the youth in town, and provides them with an explanation for a certain new environmental phenomenon, namely climate change (p 121).

Hence it was interesting to note that during research regarding perceptions of the climate crisis in Haʻapai, Havea (2020) reported that one teacher pointed to traditional knowledge as providing a means to address climate change. This teacher gave the following practical example:

> "…the Ministry of Education should introduce the traditional ideas of doing things, such as cooking, in the curriculum. For instance, instead of using aluminium foil for wrapping lū (traditional food made of taro leaves, meat and coconut cream), students should be taught and encouraged to use banana leaves, the olden days style should be reintroduced… (Tilila, 31, TFG2)". (Havea, 2020, p. 155 - 156)

Given the tension that exists between the positioning of TEK and western scientific knowledge in schooling in both case study societies, this thesis considers how teachers of science are encouraged to present climate change, and more broadly, the environment, in Haʻapai and Port Vila school settings. Tonga and Vanuatu have been frequented by cyclones, described as 'climate-related [weather] extremes', by the Intergovernmental Panel on Climate Change (2014, p. 6). In January 2014, Category 5 TC Ian hit the Haʻapai island group in Tonga resulting in more than 2,300 people seeking shelter (united Nations Office for the Co-ordination of Humanitarian Affairs (UN OCHA), 2014) . In March 2015, Category 5 TC Pam hit Vanuatu, affecting all six provinces and according to the Vanuatu National Disaster Management Office, this resulted in 50,000 people receiving emergency shelter assistance (UN OCHA, 2015) .

Vanuatu was later hit by Category 5 TC Harold in April 2020 during its Covid-19 response which included closure of international borders (Steenbergen et al., 2020). Fiji was also hit by Category 5 TC Yasa in December 2020 and their recovery was further compounded by the country's need to respond to Covid-19. Most recently, another Category 2 cyclone (TC Ana) hit Fiji in January 2021. Due to a range of historical socio-economic and geographic factors in the South Pacific region, extreme weather events often result in disasters (Johnston, 2015).

Sea level rise and coastal erosion are also environmental challenges facing the communities of Haʻapai and Port Vila. For example, a report from the SPC (2014), reported that an earthquake in 2006 had caused the coast of Lifuka to subside by 23cm, instantly causing sea level rise. Residents consequently reported a, "loss of shallow, inshore fishing grounds since the subsidence ... [and] saltwater intrusion into [their fresh] water supplies" as well as other effects (SPC, 2014, p. iii). Furthermore, satellite imagery of Pangai suggests that the beach has receded up to 40 meters in the past 44 years (SPC, 2014) . Similar to Tonga, the impact of sea level rise in Vanuatu is "exacerbated by Vanuatu's geographic location on a tectonically active subsiding area" (Kouwenhoven, 2013 as cited in Pederson Zari et al., 2019, p. 7).

Human actions such as sand extraction and mangrove destruction can also worsen sea level rise impacts, particularly in areas of coastal development such as Mele, a village near Port Vila (Secretariat of the Pacific Regional Environment Programme (SPREP), 2017). According to the IPCC, warming of the ocean has led to degradation of coral reefs globally and this threatens livelihoods, including cultural dimensions, as access to traditional food can be reduced (Oppenheimer et al., 2019). At the time of my fieldwork in Haʻapai (September, November 2015), the *Science Syllabus for Secondary Schools* (Tonga Ministry of Education and Training, 2015), used by participating teachers, did not explicitly mention climate change in the section regarding aims for secondary education.

One of the guiding principles in the Tongan secondary school science syllabus, however, emphasised the need for students to "participate in the wider world" (Ministry of Education and Training, 2015, p. 4). This statement could therefore be interpreted to require that students be enabled to build their capacity to make informed decisions about their health and environment. The overarching themes are where environmental concerns emerge, particularly under the theme Education for Sustainable Development (ESD) which is presented with an acknowledgement of the dependence of Tongans on the land and ocean and how cultural activities "reflects a concern with preserving the environment" (Tonga Ministry of Education and Training, 2015, p. 5).

In Tonga, the secondary school science Syllabus is organised into five units: *Scientific Skills and Attitudes*; *Living World* (preparation for Biology in senior secondary); *Physical World* (preparation for Physics); *Material World* (preparation for Chemistry); and, *Planet Earth and Beyond*. In Years 9 – 11, students will learn about climate change as part of the *Planet Earth and Beyond* unit. In Year 10, this unit is organised into subunits which include: (i) Earth System; (ii) Atmosphere; (iii) Hydrosphere; and, (iv) Geosphere. The subunit

Biosphere, which links terrestrial and marine life with greenhouse gas production and composition, was added to the *Planet Earth and Beyond* unit in a revised edition of the science syllabus (Tonga Ministry of Education and Training, 2017).

Each unit in the Tongan secondary school science syllabus contains 'Know' and 'Do' statements, which are used to determine formative assessments of students' knowledge and skills. Examples of Know and Do statements in the *Planet Earth and Beyond* unit regarding climate change are provided in

Table 2.1 below.

What students should KNOW	**What students should be able to DO**
Atmosphere	
5. Origin and nature of some natural disasters	ii. Explain using equations how chloro-fluorocarbon, CFC from refrigerators and air conditioners, can affect a lot of ozone molecules; and use this example to explain one of the causes of 'ozone depletion' iii. Differentiate between effects of ozone depletion and 'green-house effect' on global warming and human lives.
Hydrosphere	
8. Features and importance of the water cycle and ocean circulation	ii. Explain the features and importance of the water cycle and state its six main parts (evaporation, transpiration, condensation, precipitation, runoff and sublimation).
9. Water management and natural disasters	v. Describe effective ways of managing water for human consumption after natural disasters.

Table 2.1: *Science Syllabus for Secondary Schools in Tonga Class 9 – 10, adapted from pages 40 and 41 in Ministry of Education and Training (2015)*

Year 10 science students are therefore required to complete a research project worth 20% of their final grade on one of the units of their choice. If students chose *Planet Earth and Beyond*, they would be required to discuss local effects of greenhouse gases in Tonga, providing photographs and literary evidence. Other learning outcomes were also related to climate change such as in the *Living World* unit where students are required to "Draw, label and explain the importance of nutrient (carbon and nitrogen) cycles" (Tonga Ministry of Education and Training, 2015, p. 32). The prescribed learning outcomes are general and not specific to students' communities. Hence, teachers would need to contextualise the syllabus to fully realise the guiding principle of the Tongan secondary school science syllabus, which requires student "recognition of the uniqueness of Tonga, its people and culture" (Tonga Ministry of Education, 2015, p. 3).

It is therefore interesting to consider this guiding principle in relation to the work of 'Otunuku et al. (2017), who found that a major concern of school administrators is that the language of assessment in Tonga is English:

> Yet, assessments often confuse the language skills of examinees with their academic abilities. The major concern among educators is that any test is, to some degree, a test of language proficiency. In Tonga's case, this becomes a test of English as a second language ability. As the normal practice in Tonga is that exams are written in English, except for the Tongan language studies papers. It is highly likely that the students with higher English language proficiency are advantaged while others are discriminated against by their skills in a language that is not their own. (p. 18)

This finding consequently suggests that the insistence on English language as the medium for assessment, runs the significant risk of contradicting one of the stated aims for secondary schooling in the science syllabus. That is, the science syllabus (including modes of assessment) should enable students to "be proud of their Tongan identity and knowledgeable about Tongan culture and values" and to "exhibit high levels of literacy in Tongan and English" (Tonga Ministry of Education and Training, 2015, p. 2). This state of affairs, additionally, draws attention to the work of Hough and Skutnabb-Kangas (2005), who raised concerns over the loss of Indigenous languages in which TEK is "encoded" (p 119). Ultimately, understandings of the environment are communicated and constructed through language.

In Tonga, for example, Havea (2014) found that villagers in Tongatapu, in discussions about the climate crisis, were confused about the difference between climate and weather. They used the words feliuliuaki 'o e 'ea – the term for climate change coined by the Tonga Ministry of Environment and Climate Change – when they spoke of either climate or weather. Similar

conclusions were drawn by Havea (2020), when speaking to students, who noted the same word used in Tongan for both climate and weather:

> In the Tongan language, the term feliuliuaki refers to unpredictable, unstable or changeable, and climate is used interchangeably with the term weather. ‘Ea in the Tongan language can be referred to either: weather; climate; or air. In the questionnaire, students were asked to explain what they thought climate change is. It is evident from students’ responses, that climate change was conceptualised as changes in weather on a daily basis, in other words, the Tongan language version of climate change may have had an impact on students’ definitions about it. (Havea 2020, p. 131-132)

Likewise, Fa‘anunu (2017) also recommended that with regards to public communication about climate change in Tonga, differentiating between changing weather and changing climate is essential. This is due to the shared meaning of the word ‘ea. In contemporary Tongan society, my review of academic literature suggests that further research is needed on how transliterated terms and traditional terms are used to construct and communicate understandings about the environment.

With regards to the situation in Port Vila, I found that *the Vanuatu National Curriculum Statement* includes Ten Essential Cross-Curricular Components, which are “matters that connect with all subjects, linking learning activities in school with life outside school … These components unify ideas, giving relevance to learning at school, and assist young people to make sense of their world” (Vanuatu Ministry of Education, 2010a, p. 38). Of particular relevance to this thesis is the component *Environment and sustainable production* (Vanuatu Ministry of Education, 2010a). Under this component, a whole school approach is recommended.

> Each school should develop a vision and mission for their immediate environment; identify roles that administrators, teachers, students and families will play in supporting their environment and plan and take action on local environmental issues. Teaching and learning experiences should include concepts about conservation, social justice, cultural diversity and appropriate development (Vanuatu Ministry of Education, 2010a, p. 45).

The importance of preserving culture is repeated throughout the cross-curricular components. The Communication – Signs and Symbols component aims to ensure younger generations value their cultural heritage, which includes communication through traditional symbols, such as a namele leaf indicating a taboo place, while also learning how to confidently use information and communications technology (Vanuatu Ministry of Education, 2010a). The use of vernacular languages among young children is encouraged under the component

Literacy Education. However, in secondary schooling there is no provision for learning vernacular languages given that secondary schooling in Vanuatu is either conducted in English or French.

Vanuatu has the highest language density in the world, with 138 vernacular languages along with the lingua franca – Bislama (François et al., 2015). As a result of globalisation and urbanisation, many Ni-Vanuatu people moved to Port Vila from around Vanuatu to access schooling and trade (Leslie, 2013). This results in a diversity of languages and cultures among students in Port Vila classrooms, since students' families have come from various parts of Vanuatu. As Kraemer (2013) found, this permanent migration in Vanuatu can result in second-generation youth born in Port Vila who are not familiar with the languages or ways of their parents' home islands:

> It is not uncommon for the media in Port Vila to argue that unemployed town youth be sent back to their home islands, especially following incidents of youth violence or criminality. Young men like Jojo and the Kingston-4 boys respond to these conflicting assertions exclaiming: 'Where will they send us? We were born in town. We grew up in town. We have been educated in the ways of town, not the ways of the island!' … For them growing up in town has constituted them in different ways from their rural counterparts. (Kraemer 2013, pp. 27 - 28)

During my research, it soon became apparent to me that many teachers in Port Vila used the now somewhat dated *basic science for Vanuatu: Year 10 Teacher's Guide* (Vanuatu Ministry of Education, 1997a). This presents Year 10 science in five topics: (i) *Forces*; (ii) *Particles*; (iii) *Electricity*; (iv) *Health and Hygiene*; and; (v) *The Biosphere* (Vanuatu Ministry of Education, 1997a). The Biosphere is the topic most concerned with environmental issues, and the teachers' guide reminds science teachers that they should be aware of the concepts already taught in *Population Education* unit in Year 10 social science as well as the *Using Resources* unit in Year 8 social science (Vanuatu Ministry of Education, 1997a).

Notably, the subunit of the *Biosphere* unit, titled *Environmental Pressures*, has a strong conservation focus and makes mention of greenhouse effects as well as sea-level rise. Relevance to everyday life is also stated as a key focus of the *basic science for Vanuatu: Year 10 teacher's guide* (Vanuatu Ministry of Education, 1997a) given that it is the last mandatory year of basic science in Vanuatu. Evidence of this aim for relevance may be shown through linking scientific concepts such as conservation to the *Vanuatu National Conservation Strategy*. Certain assessment objectives in the teachers' guide are also linked to field trips. For example, "describe some examples of the ways in which producers, consumers and decomposers are adapted to obtain their needs in a local environment which they have studied

(e.g. reef, bush, river)" (Vanuatu Ministry of Education, 1997a, p. 47). Other assessment objectives are linked to social issues. For example, in the section on Food Webs, students are expected to:

> Explain and use appropriately the terms "introduced species" and "biological control" referring as appropriate to Lantana, the African snail, Rose beetle and guppies as local examples; ... Be aware of the threat of the crown-of-thorns starfish to local reefs and of the possible relationship of this threat to the collection of its predator the Triton, as a tourist souvenir; (Vanuatu Ministry of Education, 1997a, p. 51)

General assessment objectives, not immediately linked to a Vanuatu context, are also prevalent. For example, the Vanuatu Ministry of Education (1997a) required students to "explain in simple terms how oxygen, carbon and nitrogen are recycled" (p. 49) and "understand pyramids of numbers and biomes and be aware of the superiority of the latter as indicator of the transfer of energy in an ecosystem" (p.49). How are these assessment objectives framed in a way that is directly relevant to the students' lived experiences of life in their local environments? That question remains difficult to answer, largely because there is a gap in literature concerning how secondary science teachers in Port Vila engage themselves and their students with local knowledge, which may not be readily accessible to them given the cultural and linguistic diversity of teachers and students in Port Vila. Furthermore, like teachers in other countries (such as Aotearoa New Zealand), science teachers in Vanuatu must strive to contextualise curricula for their students within "the rigidly mechanical nature of school timetables" (Manning, 2009, p. 248).

Globally, Environmental Education (EE), Education for Sustainable Development (ESD) and Climate Change Education (CCE) represent separate ways of engaging in learning regarding the environment. According to Jenkins and Jenkins (2005), ESD appears to have a more holistic approach than EE, with its explicit focus on economic, environmental and social development. However, a review of environmental issues in the Pacific – from American and French nuclear testing in the region to the exploitation of natural resources in West Papua by mining companies in partnership with Indonesia while local people are oppressed – requires ESD to include the political dimension which some EE has (Jenkins & Jenkins, 2005).

The UN remains committed to ESD, having declared 2005–2014 the UN Decade on ESD and 2015–2019 the *Global Action Programme* on ESD and recently adopting a framework titled ESD for 2030 (UNESCO, 2020). ESD is increasingly recognised as a key enabler for achieving the Sustainable Development Goals which include Climate Action (Goal 13) (UNESCO, 2017a). In 2006, Pacific education ministers endorsed the *Pacific Education for*

Sustainable Development Framework which has a stated goal "to empower Pacific peoples through all forms of locally relevant and culturally appropriate education and learning to make decisions and take actions to meet current and future social, cultural, environmental and economic needs and aspirations" (SPREP, 2006, p. 2). While ESD is one of the five overarching themes in the *Curriculum Framework* for Tonga 2014 - 2019 (as cited in Tonga Ministry of Education and Training, 2015; 2017), it does not feature in the *Vanuatu National Curriculum Statement* (Vanuatu Ministry of Education, 2010b).

Climate change continues to be presented as a concern of ESD. At COP15, the 15th meeting of the Conference of the Parties to the Convention on Biological Diversity, UNESCO launched its *Climate Change Initiative* comprising four core programs including CCE in the overall context of ESD. It was recommended that CCE in the overall context of ESD be integrated in a transdisciplinary manner into existing subjects, particularly noting the potential for CCE to enhance "the relevance and quality of Science teaching" (UNESCO, 2010, p. 12) . Hence, using science education to fulfil the goals of ESD presents a goal of education for participating in society, contrasted with the rote learning of facts (Stuckey et al., 2013).

ESD has an explicit focus on transforming the world, and learning outcomes provided by UNESCO reflect this by dividing these into three domains, the cognitive, socio-emotional and behavioural domains (UNESCO, 2017a). ESD does not only influence content but also pedagogy:

> Thus, ESD does not only integrate contents such as climate change, poverty and sustainable consumption into the curriculum; it also creates interactive, learner-centred teaching and learning settings. What ESD requires is a shift from teaching to learning. It asks for an action-oriented, transformative pedagogy, which supports self-directed learning, participation and collaboration, problem-orientation, inter- and transdisciplinarity and the linking of formal and informal learning. (UNESCO, 2017, p. 7)

In Vanuatu, Lumelume (2007) recognised that an exam-oriented curriculum maintains teacher-centred practices such as rote learning. Science teachers participating in research on the role of questioning in science classes in Tonga, "felt that in practice, a combination of traditional teacher-centred classrooms and cultural factors meant that minimal questioning occurred" (Bay et al., 2016, p. 4). This raises questions of how ESD could shape science education in school settings where teacher-centred teaching and high-stakes testing is prevalent.

While ESD is useful in foregrounding climate change, it may assume a western worldview and limit the value that Indigenous worldviews and knowledge have in a given

context for developing sustainability competencies (Demssie et al., 2020). As a result, Beumelburg (2016) proposed that ESD should be contextualised in Mangaia, (Cook Islands) by using a native concept of traditional livelihoods (oraanga Mangaia) as the central concept rather than being one facet of a western vision of sustainable development. However, beyond proposing that western frameworks of education can be contextualised for Indigenous settings, an Indigenous scholar Kyle Whyte (Potawatomi) brings this stark warning:

> Colonial oppression that is allegedly defensible by real or perceived crises happens right now too. Today, people perpetrate colonialism in the name of responding to environmental crises – *climate change* being one prominent case. (Whyte, 2020, p. 52).

Whyte (2020) explained that the epistemology of crises perpetrates colonialism and stands in contrast to an epistemology of co-ordination found in certain Indigenous traditions:

> Different from crisis, coordination refers to ways of knowing the world that emphasise the importance of moral bonds – or kinship relationships – for generating the (responsible) capacity to respond to constant change in the world. Epistemologies of coordination are conducive to responding to mundane and expected change without validating harm or violence. Epistemologies of coordination are not offered here as some sort of ultimate solution to the current challenges people across the globe are facing. Although I've no problem claiming that epistemologies of coordination are much needed approaches to knowledge in education, culture, and society. Their practice would go a long way to transform unjust and immoral responses to real or perceived crises. (Whyte 2020, p. 53)

Providing examples of Indigenous peoples resettled (and those in power deciding where to) due to coastal erosion in the USA or in Mount Eglon National Park of Uganda in the name of climate change, Whyte (2020) argues that we must think carefully about how we undertake climate action:

> In thinking through the implications of unprecedentedness and urgency, climate change, as a concept, is a rhetorical device that people invoke so they can believe they are addressing a crisis without having to talk about colonial power … Epistemologies of crisis then mask numerous forms of power, including colonialism, imperialism, capitalism, patriarchy, and industrialisation. (Whyte 2020, p. 57)

This argument, in turn, drew my attention to work elsewhere in the wider Pacific Rim and to the work of Griffin (2020) who warned that, when developing climate change research with Indigenous communities, we "must attend to these historical struggles, modes of endurance, and collective aspirations for sovereign, healthy, and resilient futures" (p. 343). Elsewhere, and more closer-to-home in the Pacific region, Ratuva (2014) reviewed examples of social protection mechanisms in the Pacific such as kinship and argued that these

mechanisms contribute to adaptability and resilience but are neglected by international indexes, perpetrating a superiority myth:

> The notion that some states have failed or are failing has gained prominence in recent years and this has been reinforced by the creation of classificatory schemas such as the Failed States Index (FSI) developed by the Fund for Peace, World Bank's Governance Index (GI) and the Social Protection Index (SPI). Predictably, the Pacific Island states are ranked on the lower end of the global stratification because in most cases, the measuring variables used are culturally, historically and ideologically biased in favour of neoliberal and Western paradigms and tend to ignore the worldviews and unique cultural dispositions and historical realities of subaltern post-colonial communities. (Ratuva 2014, p. 41)

Ratuva also cautioned against portraying these traditional mechanisms, such as communal obligations and communal work, as static since individuals engage in them in dynamic ways with various motivations as communities and cultures evolve. For example, communal work in rural Vanuatu involves people reciprocally helping each other in work such as gardening or building and in urban Port Vila, hence workers may "still rely on collective labour to subsidise their low income" (Ratuva 2014, p. 52).

Similarly, Regenvanu (2010) advocates for the recognition of the value of the traditional economy in Vanuatu, which also functions to establish, maintain and mend social relationships, to be considered as "not as a problem to be solved, but rather as an enormous asset to be utilised" (p. 33) by the likes of science teachers, adding that:

> To use a current example from Vanuatu, the simple act of leasing and clearing a piece of land would add to Vanuatu's GDP – and therefore count as positive "development of the economy" – because the lease of the land, the hire of the bulldozer and the chainsaw, the purchase of the fuel to run them and the payment of labour can all be counted in cash. What would not be counted in cash would be the loss of gardening land and access to bush resources for the children of the land-holding family for at least two generations; the cutting down of ancient trees and the clearing of bush that provides habitat for wildlife and holds the rainwater in the ground; the pollution of the air, land and water with fuel and chemicals; the destruction of cultural sites important to identity; the weakening of the natural sea barrier resulting from removal of sand; and whether the amount each labourer was paid constituted a decent living wage. (Regenvanu, 2010, p. 32)

Regenvanu (2010) also makes a strong claim that primary and secondary schooling can lead to a loss of the skills and knowledge youth need to take part in the traditional economy. This calls for critical consideration of the development that ESD may promote.

Boyer (2006) highlighted that despite the development of cultural standards by the *Alaska Rural Systemic Initiative* promoting Indigenous culture and languages within schools, schoolteachers lacked skills to integrate native culture into the teaching of science and math.

A program called *Math in Weaving* helped teachers learn native weaving and appreciate the mathematics in this art form which they could adapt and put into practice with their students to learn mathematics concepts. In Hawaii, the Kaiao Garden provides an example of community efforts to encourage food sovereignty, threatened by the high amount of imported food in Hawaii (Meyer, 2014).

Attention to place has also provided many Indigenous communities with the means of incorporating cultural values and ways of knowing the environment into schooling through PBE. For example, Te Pā o Rākaihautū, a special character school in Ōtautahi (Christchurch, New Zealand) celebrates links between culture and place to reshape pūtaiao (science) curriculum as described in the quote from Macfarlane et al. (2019), below:

> Te Pā weaves together traditional Māori epistemologies, ontologies and pedagogies with Western scientific teaching methods to enable learners to enjoy educational success as Māori. At its core, this community-based education model is family-centred and reframes the question of what a Science Education should look like in a modern environment by intentionally reconnecting families with ancestral places, genealogy and traditional narratives that ground people in their own tribal location. (p. 459)

Te Pā has carried out the production of kai and compost on-site and also developed an eco-friendly cleaning product using citrus peelings from school lunches, adopting a "'closing the loop' ethic which is very important to the future of place-based learning" (Leckie et al., 2020, p. 15). The Indigenous knowledge which is "rooted in long inhabitation of a particular place" (Barnhardt & Oscar Kawagley, 2005, p. 9) can therefore open pathways to designing science curriculum guidelines that support alternative ways of living in our search for sustainable relationships with the planet we inhabit as Indigenous peoples of the Pacific Ocean.

Curricular context in Tonga and Vanuatu

In evaluating the curriculum development processes in Tonga and Vanuatu, key differences are to be noted regarding education legislation in each country which impact the way education is delivered. Firstly, according to Section 98 of the *Tongan Education Act* (2013), participation in schooling in Tonga is compulsory, from age 4 to 18 years, for every child in Tonga (Education Act 2013). According to the 2016 Tongan census, 95% of children aged 5 to 14 were enrolled in schooling, with the highest participation occurring in the Haʻapai island group and the lowest participation occurring in the Niua islands (Tonga Statistics Department (TSD), 2017).

In contrast, schooling is not compulsory in Vanuatu "due to the island-state nature of the country, with many remote and isolated populations" (Vanuatu Ministry of Education and

Training, 2020c, p. 5). However, total enrolment in primary schools and early childhood care and education in both rural and urban areas has been increasing in recent years and this has highlighted the need for the Ministry of Education and Training to increase access to secondary schools since "there are not currently enough secondary schools to accommodate all students" (Vanuatu Ministry of Education and Training, 2020c, p. 8). This raises an important question – who are the secondary school education providers in each country?

In Section 3 of the *Tonga Education Act* (2013) states that, "every child in Tonga shall have the right to receive a quality education" (p. 14). Over 80% of primary schools are operated as government schools and the remainder are private/mission schools (Tapa'atoutai-Teisina, 2020). In 2014, there were a total of 54 secondary schools operating across the various island groups of the nation (Tonga Ministry of Education and Training, 2014a). Tapa'atoutai-Teisina (2020) reported that over 70% of secondary schools are mission/private schools, with the remainder run by the Tongan Government. The following observation of 'Otunuku et al. (2017) below, further highlights how a culture of assessment-driven teaching has become all too prevalent in Tongan secondary schools – impacting upon the design, delivery and evaluation of science education:

> These government high schools were seen as having the best resources for learning, and the school fees were less expensive than those of the schools administered by the churches. For these reasons, pressure to attain scores to enable access to the government schools has been a strong driving factor in the development of Tonga's current culture of high stakes testing. ('Otunuku et al., 2017, p. 8)

In Vanuatu, schools are, likewise, owned and operated by "either by government, church or private individuals/organisations" (Vanuatu Ministry of Education and Training, 2020c, p. 13). In 2019, schools owned and managed by the Government accounted for 53% of secondary schools and 64% of primary schools (Vanuatu Ministry of Education and Training, 2020b). Schools in Vanuatu are distinctly divided along lines of language of instruction, a colonial legacy – which also inevitably impacts the design, delivery, assessment and evaluation of the science curriculum:

> Like many countries through the Pacific, western education began in Vanuatu with the missionaries' arrival to the islands in the early 1800s, and traditional forms of education began to dissipate as Ni-Vanuatu began converting and spreading the message of Christianity. By 1860, six mission schools were established, teaching Ni-Vanuatu to read the Bible through Indigenous languages (Robert 2005 and Khan 1984). As the missionary population increased, France and Britain began competing for influence in the archipelago and eventually agreed upon a joint annexation where both countries ruled from 1906 to 1980. As a result, they employed dual systems of government, and eventually education. Racing to maintain influence in a fast

> becoming independent nation, the French and British colonial government began opening schools, taking over missionary schools, and spreading formal education throughout the country. (Shipman, 2008, p. 6)

In 2019, out of the 111 secondary schools in Vanuatu, 69% are Anglophone and 31% are Francophone (Vanuatu Ministry of Education and Training, 2020b). The language of instruction in a school is agreed upon by the community since communities in Vanuatu were either historically English speaking or French speaking (Vanuatu Ministry of Education, 2012).

The language policy of each country shapes the socio-cultural context in which science education programmes are designed, delivered, assessed and evaluated in schools in Vanuatu and Tonga. For example, Vanuatu has three national languages, the colonial languages (English and French), the *lingua franca* Bislama, as well as more than 100 vernacular languages – showcasing the linguistic and cultural diversity of the archipelago (François et al., 2015). According to the Vanuatu National Language Policy, teachers must:

> …teach in either French or English in all schools. However, in the first two years of school, Bislama or a local vernacular can be used while either French or English is introduced by the second semester of Year 3. By the end of Year 3, the language of instruction should be either French or English. (Vanuatu Ministry of Education, 2012, p. 2)

In secondary schooling, the language of instruction would be either English or French as one of the policy objectives is to, "support the teaching and learning of French and English as the official languages of education from Year 3 to Year 13 and recognise the importance of beginning education using children's first language or mother tongue" (Vanuatu Ministry of Education, 2012, p. 2) Meanwhile, students in years 9 and 10, attending English schools, are required to take French as a foreign language and vice versa.

One interesting aspect of the Vanuatu Government's language policy is its stated support of "plurilingualism" defined as, "the totality of an individual's linguistic competences in and across different languages, which develops throughout life" (Vanuatu Ministry of Education, 2012, p. 19). One commentator acknowledges this policy is significant in providing space for the vernacular languages in Vanuatu education (Willans, 2016). This suggests vernacular languages can play a significant role in students learning about their local environments. Hence, Willans (2016) provided an example where a teacher in a Francophone school had asked students to provide examples of plants that had seeds dispersed by animals. Students named plants in the local vernacular language which "enables the pupils to draw on their own knowledge of the fruits and nuts growing around them" (p. 706).

Elsewhere, a speaker of the Malekula Ahamb language reported to researchers that, "here in the bush we teach our kids the names of all the plants and animals in [the vernacular] language" (Rangelov et al., 2019, p. 118). However, it was acknowledged that not all vernacular languages, particularly those with less speakers such as the Ahamb language, have the resources and institutional support to implement this policy (Rangelov et al., 2019).

With regards to the Tongan context, Koloto (1998) points out that, "although Tonga was never formally colonised, it too did not escape the effects of colonisation. This was evident in the type of government and education system that were set up, both based on the British system" (p. 122). In Tonga, schools run by churches and their affiliations with overseas partners, largely influenced curriculum development. As Palefau (2005) explained it:

> The curriculum adopted in schools during the 1960's was determined by each church group … The chaos of the situation was to be deplored, but to reorganize for an effective education system, there needed to be cooperation between churches, a unification of efforts and an agreed unanimity about the aims and purposes of education for Tonga. As a result, Paongo (1997) reports, most of the development work for the national curriculum was funded by aid donors and organisations like Australian Aid, New Zealand government, USP [University of the South Pacific] and UNESCO. (p. 48)

The Curriculum Development unit was established in Tonga after the termination of the united Nations Development Program/UNESCO driven Secondary School Curriculum Project Tonga had participated in with other Pacific Island Countries (Taufeʻulungaki, 1979). The Curriculum Development unit was set up under the Ministry of Education with the intention "to develop curriculum materials meaningful to Tongan students" (Koloto, 1998, p. 125).

The official language policy for Tonga is published in the Tongan language and is titled, *Fokotuʻutuʻu ki he Lea ʻo e Akó ʻi Tongá ni* (Tonga Ministry of Education and Training, 2014b). It recognises the Tongan language as the main language of religion, parliament, government, business, and national affairs as well as the main language of communication between families. This language policy also promotes bilingualism, as the Tongan language is exclusively used in the first three years of schooling and English is introduced as a subject in Class 3 and gradually increases in its usage until instructional time is split evenly between the two languages from Form 1 - 7 (Year 7 – Year 13).

The policy also recognises the minority language of Niuafoʻou as another Indigenous language of Tonga. The Tongan language policy advocates for bilingualism, with Tongan positioned as the first language, emphasising the importance of being fluent in the mother

tongue for future learning and communication as well as providing the critical link between language and identity:

> ‘I he mole ha Lea ‘a ha fonua ‘oku mōlia atu mo ia ‘a e ngaahi me‘a ‘o e tukufakaholó mo e anga fakafonuá hangē ko e ngaahi ongo mo e tefito‘i tui pea mole mo ia ‘a e ngaahi faka‘ilonga ‘oku nau fakafaikehekehe‘i ai kitautolu kakai Tongá mei ha toe fa‘ahinga kakai. (Tongan Ministry of Education and Training, 2014b, p. 3)

The above statement warns that language loss is associated with loss of what has been passed on from previous generations, culture and the very distinctive features that set Tongans apart from other peoples. However, despite this policy, “English is increasingly perceived as having higher status than Tongan. There are signs of community language shift to English, and some community pressure for the teaching of English to be the key outcome of education” (Taufe‘ulungaki et al., 2020, p. 36). This may be further evidence for the claim of Otsuka (2007) that the Tongan language is an endangered language and the perceived benefits of English through globalisation are masking the cost.

From a socio-cultural perspective, this raises questions regarding how the language used in science classes (influenced by national language policies) is different to surrounding sub-communities and with what “larger-scale social consequences” (Lemke, 2001, p. 299). In Pacific communities, the home language may be different to the school language. In the Solomon Islands, it was found that incorporating the vernacular Natqgu language in school could enhance community engagement (Taufe‘ulungaki et al., 2020). However, in PNG, which has more than 800 vernacular languages, efforts to start schooling in vernacular languages faced difficulties with “no equivalents to many English or scientific terms in many of the Indigenous languages of Papua New Guinea” (Najike, 2004, p. 5).

In Samoa, where assessment tasks are presented in the English language, Lee-Hang (2011) found that teachers encountered language problems because English is a second language and this poses problems when translating the technical nature of the language of science. A participant in this study reported that this difficulty with language can lead students to rely on memorizing notes given out by the teacher to answer assessment questions rather than using “their own knowledge and skills” (Lee-Hang 2011, p. 143). In contexts where science students are learning in their second language, such as the case for many students in Samoa, Tonga, Vanuatu, PNG and Solomon Islands – the use of contextualised science activities to assist with language development may be considered.

> Tolbert et al. (2019) asserted that in contextualised Science activities students can contribute their own funds of knowledge, as well as build on and respond to similar

> contributions from their peers so that knowledge is coconstructed and mediated through multiple perspectives. In this sense, contextualizing Science activity helps create meaningful opportunities for scientific sense-making and productive language use, whereby teachers ideally leverage contextualised Science activities to facilitate student sharing, collaboration, and dialogue —fundamental to both Science learning and language development. (pp. 1072 - 1073)

My review of the literature, therefore, suggests there is a need to continue to share research on how teachers and students in Pacific communities navigate the challenges of language development and its impact upon science learning in their schools, especially as community language practices may continue to evolve and shift.

Schools in Vanuatu are distinctively Anglophone or Francophone, having inherited separate languages of instruction and curriculum from the former colonial powers, Britain and France. However, the *National Curriculum Statement* (Vanuatu Ministry of Education, 2010a) was developed in recognition of "the need to harmonise the curriculum for Francophones and Anglophones so that all children follow the same curriculum and have the same opportunities irrespective of their language background" (p. 2). In Vanuatu, students sit multiple national (or external) examinations throughout secondary school, including in Year 10, heavily influencing classroom activities (Robert, 2004). Vanuatu has undergone significant changes in secondary school assessment since independence, having used assessments from England and Aotearoa New Zealand as well as the regional Pacific Secondary School Certificate administered by the Fiji-based South Pacific Board for Educational Achievement (SPBEA) (Tarosa, 2013).

As a point of commonality, Tonga and Vanuatu had both used the SPBEA Year 12 and Year 13 assessments but Tonga nationalised their Year 12 assessment in 2012 (Vaka-Vivili, 2014) and Vanuatu nationalised Year 12 assessment in 2014 (Tarosa et al., 2016). In 2015, the Ministry of Education in Tonga introduced the use of the *Structure of Observing Learning Outcomes Taxonomy*, raising concerns over whether both government and private schools in Tonga were prepared for this change in terms of teaching training and alignment with the curriculum (Lātū, 2018). From my review of the literature, it appears that the education systems in Tonga and Vanuatu have gone through considerable changes in terms of assessment and development of national curricula. Further research is needed to better understand the impact of these changes in the practice of science teachers and the learning of science students in various school settings. Science curriculum development in the Pacific, after all, requires cultural analysis involving, "an examination of a society's culture, language, technology, knowledge, beliefs and values, in order to make better judgments about what ought to be

transmitted to the next generation – in other words, what is worthwhile to teach and learn" (Thaman, 1990, p. 5).

The Rethinking Education in the Pacific colloquium held in Fiji in 2001, led to Vanuatu educators nationally taking up the initiative and challenge to rethink their education, leading the way in the Pacific with their landmark Port Vila conference in 2002 (Sanga & Niroa, 2004). Rethinking Vanuatu education was essential because, as (Niroa, 2004) noted:

> The schooling system detaches us from what we hold dear and trivializes our values, attitudes, belief systems, and knowledge, and skills that our societies have developed over thousands of years and that have ensured our survival for so long … The schooling process has ignored our local knowledge as legitimate parts of the educational systems. (p. 26)

Elsewhere, Teasdale (2005) has argued that, whereas school curricula had been shaped by a fragmented view of knowledge, rather than a holistic view, "this had led to the compartmentalisation of knowledge into discrete disciplines" (p. 13). As a teacher-researcher, it concerns me that this compartmentalisation, has kept TEK out of secondary school science curricula, instead relegating it to social science subjects.

Hence I find Thaman's (1990) call for cultural analysis to inform curriculum development particularly pertinent. I can also see its relevance to the findings of Palefau's (2005) research which provides a valuable example from the Tongan context of secondary school science education. Through interviews with community members, Palefau explored what they believed to be useful to include in the science curriculum. One main conclusion of his doctoral research was the desire for Traditional Science and Technology (including fishing and agricultural practices, making of oils, handicrafts and traditional medicine) to be included in the science curriculum of Tonga.

Hence, Palefau (2005) recommended compulsory community involvement, or community-based education, through an apprenticeship program which "would provide every student with the opportunity to participate in, and appreciate, and experience traditional activities" (p. 417). This aligned with his finding that in village communities, participation and apprenticeship are the ways in which TKS are shared between generations. This argument, in turn, aligns with an eco-justice approach to EE, as advocated by Bowers (2001):

> An eco-justice oriented environmental education curriculum should also include helping students examine the ecological footprint of the non-commodified activities, forms of knowledge, and skills acquired through mentoring relationships--as well as learning to participate in these aspects of community life. This suggestion may appear to be outside the legitimate scope of environmental education. But if environmental educators are to address the deep cultural roots of the double bind where the

> continued emphasis on a consumer dependent lifestyle, which is being globalized, threatens our long term survival they will need to take seriously the managing of the household (ecology – in its original meaning). (p. 150)

Earlier, Bowers (2001) used Einstein's definition of a double bind as "using the same mindset to solve a problem that created it" (p. 142) and so warns that western environmental educators must be critical about how science and technology have contributed to the ecological crisis. This stance, in turn, requires careful consideration of the more sustainable lifestyles of other cultural groups – particularly those of Indigenous peoples. Indeed, TEK has important implications for resource management in Vanuatu, where it has been used in the management of threatened species (McCarter & Gavin, 2014). Namele leaves, for example, are used in Vanuatu to communicate a fishing taboo at a reef and species-specific taboo as well as seasonal-taboo have been customarily used as a form of resource management (Hickey, 2006).

Another commonality between Vanuatu and Tonga is the prescriptive nature of the curriculum. 'Otunuku et al., (2017) reported on a change mandated by the Tonga Ministry of Education and Training to use raw marks in the Form 5, 6 and 7 national end-of-year examinations rather than standardised marks. This change also led to changes in the internal assessments as:

> The privilege teachers once had in the past to design their own assessment tasks is no longer available to them. All IA [Internal Assessment] components are either prescribed in the subject's syllabus, or take the form of a CAT [Common Assessment Task] designed by the Examinations unit and which are distributed to schools to be executed. This indicated that this 'culture of testing' has removed from teachers their expectation that practice will be evidence-based and associated accountability to make professional judgement of their own. Teaching practice is now becoming a series of technist activities where 'testing scripts' is the de facto curriculum and teaching pedagogy is no longer an innovative exercise but a strict prescribed activity. ('Otunuku et al., 2017, pp. 17-18)

Theoretically speaking, Freire (1970/2005) argued that prescription in education is oppressive as "every prescription represents the imposition of one individual's choice upon another, transforming the consciousness of the person prescribed to into one that conforms with the prescriber's consciousness" (p. 47). In this prescriptive environment, therefore, it can be very difficult for science teachers in Tonga and Vanuatu to engage with local communities unless it is assimilated into the prescribed curriculum or assessment task/s (i.e., even if the teacher/community thought it would be valuable to teach something outside that rigid official framework).

Throughout the Pacific region, the ongoing and residual influence of colonial powers is evident in shaping how schooling and science education has developed and continues to evolve. For example, one only need to look at New Zealand's colonial rule in Samoa (1914 – 1962), to see that schools were patterned after New Zealand's schooling system, whereas the former colonial power, Germany, had largely left schooling to the mission schools – which focused on literacy (Lee-Hang, 2011). Samoa College, consequently, was established in 1953 during this colonial period, providing secondary education intended to produce leaders and civil servants (Lee-Hang, 2011). During Australia's colonial rule in PNG, syllabi were similarly developed using New South Wales as a model, with a national science syllabus for junior secondary school – first developed in the 1960s (Najike, 2004).

In contemporary Pacific schooling, I have seen significant evidence to suggest that foreign curricula guidelines continue to be a dominant influence in some Pacific Islands. This occurs in different ways. For example, Palau continues to use an American-styled education system although Palau gained independence in 1994 (Soaladaob, 2010). In Mangaia, Cook Islands, Beumelburg (2016) highlights the effect of using New Zealand-based curriculum and assessment in secondary schooling:

> Although many of the achievement tasks on the NZQF [New Zealand Qualifications Framework] promote place-based teaching, in practice only a few opportunities are taken. The lack of curriculum expertise, availability of localised teaching resources and time for teachers to develop their own resources, makes it difficult for teachers to provide a place-based education … The Mangaian Indigenous ecological zones, described in detail by Allen (1969), could provide the basis of a localised, ecosystem perspective in biology, yet there has been no attempt to put them into a suitable format for teaching. (p. 257)

Elsewhere, it is worth noting that the Solomon Islands schooling system was also shaped during the British colonial administration and this has left a legacy which includes an emphasis on summative assessment influenced by external examinations such as the Cambridge School Certificate (Rodie, 2014). However, it is also worth noting that a recent education reform in the Solomon Islands involved the revision of science syllabi, teachers' guides and other instructional resources, "with the aim of improving the quality of the materials, and making them more culturally relevant to the learning needs of Solomon Islands children" (Rodie, 2014, p. 29 - 30).

Developing culturally relevant curricula, alongside efforts to re-think current educational practices from planning to assessment in the Pacific has propelled forward movements such as Rethinking Pacific Education Initiative for Pacific Peoples by Pacific

Peoples (RPEIPP). This movement is "a local Indigenous response to decades-old discourse widely heard among the islands, in the literature by Pacific scholars and others on the general failure of islanders to make it successfully in the schooling system at all levels up to university" (Nabobo-Baba, 2013, p. 86 - 87). RPEIPP activities include supporting Pacific communities with research and conferences on education and culture – attended by educators and researchers from Tonga and Vanuatu. However, Burnett (2007), drawing on experiences in Kiribati, has critiqued this stance, suggesting that, "confining students to a set of local languages, cultural knowledges and ways of knowing, if it is done at the expense of languages and knowledges of power, is to profoundly limit the life chances of those students" (p. 265).

It is against this backdrop that my case study research seeks to explore how local environmental issues are conceptualised and framed by: (i) the teachers of Year 10 science in Haʻapai (Tonga) and Port Vila (Vanuatu), plus their Year 10 students. As we rethink our education systems, the voices of these key stakeholder groups cannot be ignored.

Conclusion

To reiterate, the guiding proverb of this thesis (see Chapter 1), is Pikipiki hama kae vaevae manava. This proverb, again, exhorts us to "link the outriggers of our canoes" (pikipiki hama) "so that we can share our provisions with one another" (kae vaevae manava) ('Ahio, 2011, p. 72). Hence, this literature review was guided by the essence of this proverb. To that end, I have travelled far and wide to collect, collate and analyse academic literature and policy documents to identify those that are related to local, national and international trends and relevant to the objectives of this research. For the purpose of manageability, this literature review chapter was organised around four themes also pertinent to my overarching research contexts, objectives and questions.

The first thematic section (Learning About the World: Whose knowledge?) has investigated local, national and international literature to consider whose knowledge was found to count in schooling. Here, I have drawn extensively on the works of Bourdieu and Freire to theorise the oppressive nature of exam-driven-based-education systems modelled on the schooling systems of distant countries (i.e., former and current colonial powers). The second thematic section of this chapter (Traditional Ecological Knowledge in Schooling) has reviewed selected literature on TEK and schooling in Tonga and Vanuatu settings. In this section I have also been careful to emphasise the marginalisation of TEK from science classrooms in various local, national and international settings.

To understand TEK in the local contexts central to this study (i.e., Haʻapai and Port Vila), the concepts of kastom in Vanuatu and tukufakaholo in Tonga were explored. The potential of PBE and Social/Constructivist learning theories to engage students and teachers with TEK was also considered and a key dilemma was also identified in relation to the place of young people questioning the wisdom of adults. The third and fourth themes combined reviews of the research literature with analysis of relevant national policies and educational materials from the research contexts.

The third theme central to the structure of this chapter explored climate change and pedagogy in the Pacific region. Here, I have stressed the need for science teachers and curriculum planners to support the adoption of ESD in many Pacific contexts. My review of the literature in this section also highlighted the need for critical consideration of how the belief and social systems of Indigenous peoples are represented and engaged with in climate change pedagogy. The last thematic section, Curricular Context in Tonga and Vanuatu, reviewed how schooling has developed and been delivered in each case study country. Particular attention was given to the selected language of schooling, given the colonial history of the Pacific region and ongoing foreign influence.

Questions have also been raised here regarding the effectiveness of establishing schooling/teacher practices and student learning outcomes. In Vanuatu and Tonga, my review of the literature suggests an emerging consensus amongst academics that high stakes examinations appear to drive classroom activities with negative outcomes. This raises further questions related to the extent to which this culture of assessment, intertwined with rigid school timetables, may hinder or promote student engagement with local environmental issues in Pacific region schools. Ultimately, students will seek to make sense of the TEK, school science, and religious beliefs, which often possess conflicting views regarding their relationship with the environment. Hence, questions arise that how students conceptualise their local environment will likely reflect the influences of their familial/community cultures and those of the schooling systems they encounter.

There is, for example, a clear gap in the literature regarding what Year 10 students in Port Vila and Haʻapai perceive to be the goals of their science education, and what they, on the other hand, believe is important to learn. This literature review has also helped me to consider other barriers to meaningful student engagement with science education. For example, the role of national examinations, accompanied by the sanctioned (official) language of instruction and summative assessment serve to further distance students from their local environments. I have also paid attention to questions that deal with how local environmental issues may best be

framed in a more culturally responsive curriculum framework (whether through a lens of climate change or other understandings of what drives environmental changes).

To conclude, this chapter reviewed literature to help frame my research journey by identifying and addressing recurring questions about the conceptualisations and framing of local environmental issues in Haʻapai and Port Vila secondary schools. The next chapter (Chapter 3) will, in turn, give a detailed account of the research design and methodology that underpinned my research journey. It will also outline ethical considerations relevant to each case study context.

Chapter 3 : Methodology

Introduction

This research explores the relevance of science education in relation to the local environmental issues faced in Pacific communities which are severely impacted by the climate crisis. The inspiration for this doctoral research came about after I heard of the devastating effects of TC Ian in Haʻapai, Tonga and TC Pam in Port Vila, Vanuatu. Both TCs had hit these communities with the strongest magnitude (Category 5) and underlined the significance of struggles Pacific communities face in a changing climate. The key research questions addressed by this study are:

(a) How do secondary school science students in Haʻapai and Port Vila conceptualise local environmental issues and to what extent do these conceptualisations reflect both their Indigenous knowledge contexts and formal schooling pedagogy?

(b) How do teachers present local environmental issues in their science classes and what are the implications of the pedagogical approaches used?

(c) How does Indigenous knowledge shape understandings of the environment and climate change and how can this knowledge be incorporated into western models of school science education?

I have metaphorically likened my research to a return voyage across the Moana throughout this study as it involved travelling to visit communities Haʻapai, Tonga and to Port Vila, Vanuatu and home again to Tonga. On this voyage, I employed an eclectic research design to interweave a range of qualitative research methods, including: (i) Case study methods, (ii) Autoethnography and (iii) Talanoa approaches.

This chapter (3) therefore describes this qualitative research process, which involved numerous iterative writing cycles with guidance from my supervisors that enabled me, as a Tongan teacher-researcher, to address the primary research objectives and questions in the case study settings of Haʻapai and Port Vila. The structure of this chapter begins with a theoretical framework, followed by an overview of methodological approaches used.

Theoretical framework

While I have explained my choice of using a qualitative research approach in Chapter 1, I will now outline the interpretive paradigm this research is based on. According to Cohen et al. (2017), paradigms represent "ways of looking at the world, different assumptions about what the world is like and how we can understand or know about it" (p. 8). In adopting an

interpretive paradigm, I will unpack the assumptions about ontology, epistemology, methodology and axiology which informed this study from an Indigenous research standpoint.

This study is concerned with exploring conceptualisations of the environment among Indigenous Moana communities. For Indigenous Peoples, this raises questions of:

> … how communities come to, and engage in, the process of knowing … But knowing is not enough; communities and their members must do things. The doing is reflective of the knowing … Those knowledges, and their concomitant actions, are rooted in particular values. These values might revolve around connections to land, or to other people, or living things. The spiritual components of these values must be considered as one considers how we think about both knowing and doing; these do not occur in a vacuum (Brayboy & Bang, 2019, pp. 568 - 569).

To address these questions in my research, I have used an interpretive paradigm as it acknowledges that there can be multiple interpretations of a situation or problem as human experience is subjective (Cohen et al., 2017). This interpretive lens enables me to explore cultural understandings of the climate crisis in the Moana and how theses understandings can inform pedagogical approaches to science education.

An Indigenous epistemology calls for the recognition that how we know is shaped by our cultures and our place. From across the Moana, Meyer (2008) explained, that in Indigenous Hawaiian epistemology: "One does not simply learn about land, we learn best *from* land … Land is more than a physical place. It is an idea that engages knowledge and contextualizes knowing" (p. 219). This is reminiscent of the work of Basso (1996) with Western Apache people, who claimed that 'wisdom sits in places' – indigenous place names bearing witness of how language, environment and culture shape each other. Cultural conceptualisations of relationships to a place are unpacked in the Findings of this thesis. However, I highlight the importance of place here to the methodological design of this research which necessitated visiting places in the Moana within a case study approach. Case studies can be bound by time and place (Creswell, 2003 as cited in Baxter & Jack, 2008) and this binding made the complex nature of my study much more feasible by allowing me to limit my research objectives for what was otherwise a broad topic.

We can know a place, or the environment, through story and senses, and this highlights another epistemological claim from Meyer (2008) in that "our senses are culturally shaped" (p. 220). This idea is also found in the writings of Indigenous Tongan scholar Rev. Dr Mohenoa Puloka (2017) who asserted that

> thinking and feeling are fundamentally the by-products of personal, social, cultural and religious underpinnings of a person's environmental setting … a thinking heart as well

> as a feeling mind are equally worthy complimenting components of data analysis and meaning creation. Thus, in Tonga, "I feel, therefore I am (p. 64).

This draws attention to a key area of Tongan thinking about the importance of the loto, or heart, of a person which has informed my exploration of my research questions.

To illustrate this, I share an anecdote of when the Australian Weslyan missionary Dr Moulton originally created the motto of the first college established in Tonga, Tupou College Toloa. Moulton was familiar with Psalm 121 from the Christian scriptures which tells of help coming from the mountains or hills. Tonga, however, mainly consists of low-lying islands and few mountains or hills. He created the motto, "Ko Tonga mo'unga ki he *'atamai*" meaning that the strongholds (see Lātū, 2011, p. 58) or literally, mountains (mo'unga) of Tonga are found in the minds ('atamai) of people, celebrating Tongan thinking. However, the missionary was corrected by his Tongan companions and so the motto stands today as "Ko Tonga mo'unga ki he *loto*", emphasizing the importance of feeling to Tongans. This implies that the mind is informed by the emotional intelligence (heart or loto) of a Tongan. (M. Puloka, personal communication, 2021). This implies that in the Tongan sense, to really know is to engage your loto (heart). Only then can this knowing (of the loto) result in doing.

What bearings do these epistemological ideas have on the methodology of this research project? Vaioleti and Morrison (2019) describe Indigenous Pacific knowledge systems as being "relational, functional, and contextualized. Their basic ontology is conducive to reciprocity and respect" (p. 654). Methodologies for data collection and analysis were then chosen based on their ability to engage people at the heart level, based on the values held by the researcher and the participants.

This can be seen in my use of talanoa research methodology (discussed below) which Tongan academic Vaioleti (2013) explained can put the kau ngā fa'u (participants who are co-constructing knowledge) in "a state (of mind, heart, emotion) and power level that enables the participant to share authentically" (p. 206). Talanoa may be positioned alongside other Indigenous conversational forms "in which relationality, the state of being related, is operationalised through the reciprocation in a dynamic storied world" (Sanga, Reynolds, Houma & Maebuta, 2020, p. 2). My employment of talanoa as a methodology within an interpretive paradigm is shared in the sections following.

An auto-ethnographic approach was also used to compliment analyses of talanoa as I found myself, un-willingly at first, taking a decolonising stance towards academia as my research journey unfolded. In this stance I join others using Indigenous research methodologies in "finding ways to use the coloniser's language for decolonial analyses and drawing insights

from Indigenous knowledge and valules" (McKinley & Tuhiwai Smith, 2019, p. 5). Auto-ethnography allows me to, in a sense tell my story in my own voice (Ritchie et al., 2013) and reveal the profound personal impact my research had on me as a Tongan teacher-researcher, which I share to empower others.

As part of this decolonising stance towards academia, I employ poetry, proverb and metaphor as tools of analysis. As Puloka (2017) argued, "Poetry, within the Tongan context, is the totality of the daily living experiences as expressed in speech oratory, songs, dances and all that make sense of our personal and social relationships" (pp. 44 - 45). Thus, I pause to remember:

Yumi[1] *talanoa and found*
Common ground in fluid space
Stories became ways
To see the familiar in what was strange

I now re-trace the research journey and provide an overview of the approaches used to explore my research questions in Tonga and Vanuatu. These included a case study approach, talanoa and auto-ethnography.

Case study approach

I first visited Heilala College (pseudonym) in Ha'apai from the 9th to 19th of September, 2015, to conduct classroom observations and engage participants through talanoa sessions (in both the English and Tongan languages). Only one school was selected to participate in Ha'apai. At this school, I met with two teachers for talanoa as well as with two groups of students from their Year 10 science classes. Upon extending this study to include Vanuatu, I travelled there from the 24th of June to the 8th of July, 2016. During this time I visited the two Anglophone schools, Future College and Nurture College (pseudohyms), recommended by the Shefa Education Office (Port Vila). At each school I met with at least one Year 10 science teacher and a group of students to talanoa. All talanoa sessions were conducted in English. Profiles of participating schools and students are provided later in this chapter.

By utilising a case study design, Year 10 science students and teachers in Ha'apai and in Port Vila therefore became the two bounded systems in which my research questions were explored (Smith, 1978 as cited in Merriam & Tisdell, 2015). The case study approach adopted was selected because it recognises the inseparability of phenomenon from context (Yazan, 2015; Yin, 2014 as cited in Merriam & Tisdell, 2015). Case studies typically are, furthermore,

[1] The Bislama term for "we".

designed to focus on "society and culture in a group … This entails immersion in the setting and rests on both the researcher's and participant's worldviews" (Marshall & Rossman, 2006, p. 55). Elsewhere, Kraft (1978) has presented this helpful description of a worldview:

> A world view defines the self. It sets the boundaries of who and what *I am*. It also defines everything that is *not me*, including my relationships to the human and non-human environments. It shapes one's view of the universe, one's conception of time and of space. It influences one's norms and values (Kraft, 1978, p.4 as cited in Cobern 1991, p. 19).

A case study design also lent itself to my research because it is defined by its unit of analysis (a bounded system or a case). It is consequently different from ethnography, narrative inquiry, grounded theory and other approaches which are defined by their focus. Yet, a case study methodological approach can still be used in conjunction with these other approaches by providing the context/s in which these others are applied (Merriam & Tisdell, 2015).

Selection of case study locations

A preliminary scan of the literature drew my attention to the *WorldRiskReport* which, between its inception in 2011 until 2020, has consistently ranked Vanuatu and Tonga in the top three countries in the world for being most at risk of facing disaster (Jeschonnek, 2011, 2013; Jeschonnek & Brodbeck, 2012; Jeschonnek et al., 2014; 2015; 2016; 2017; Kirch et al., 2018; 2019; 2020). The *WorldRiskReport* calculates the risk of disaster for 181 countries in the world based on its evaluation of exposure and vulnerability to natural disasters for each country (Bündnis Entwicklung Hilft, 2020). This will be discussed in more detail in Chapters 6 and 8.

As discussed in the Chapter 2, I observed that there have been growing calls for the contextualisation of curricula and schooling in both case study societies (Tonga and Vanuatu). This is reflected in the earlier discussed RPEIPP which "was borne out of the need to ensure Indigenous and Pacific peoples increased ownership of the processes of education as well as to re-examine curriculum processes" (Nabobo-Baba, 2013, p. 83). As a teacher-researcher, I was also convinced by the wisdom of this traditional Tongan proverb 'Pikipiki hama kae vaevae manava' which alludes to the value of sharing 'at sea'. I will now unpack this proverb further to illustrate why it was selected to metaphorically guide the design of this doctoral research.

This particular proverb is increasingly used by researchers within and outside of Tonga. Gillon (2020) used it to mean "to bind or lash together the outriggers of vaka moana [ocean going canoe]; share resources" (p. 89). However, 'Ahio (2011) provides a detailed description of the Tongan meaning of the proverb by drawing on TEK. Here, I will now share 'Ahio's (2011) description:

> *Pikipiki hama kae vaevae manava* is the act of bringing together, joining or linking the *hama* [outriggers] of the canoes in order to enable the sharing or distribution of the *manava* (food). The *hama* plays a vital role in the process of *vaevae manava* by creating a balance in the canoes which gives the kind of united stability that are needed for the *vaevae manava* to be carried out successfully, especially if the canoes are in open seas or if the sea is rough. … When Tongan navigators, at sea for a number of days, catch fish, they normally come together in the open sea and share these as their main food supplemented with coconut. To share the catch, the outrigger of one canoe (with two to four fishermen in each canoe) is connected with the outrigger of another canoe in pairs, and pairs of canoes either form a circle or a line … When the hulls [of the canoe] are lying closely together they can share their food. (ʻAhio, 2011, p. 72)

What is the relevance of this proverb to my research? I have lived out this proverb in a unique way during my university studies in Aotearoa New Zealand alongside other Pacific Island students. We often found ourselves sharing – food, notes, community connections – as we wanted each other to succeed. This collectivism reminds me of Tongan concept of fetokoniʻaki, which describes the deep cultural value of sharing in Tongan society (ʻAhio, 2011). Fetokoniʻaki was described elsewhere, by Vaioleti (2006) as reflecting a deep sense of "reciprocity and responsibility for each other" (p. 27). In this context of sharing similar Christian and Pacific values amongst fellow Pacific Island students, I learned the value of supporting other students from various Pacific Island backgrounds, not just Tongan students.

When I decided to extend this research to include Vanuatu, I realised I could learn more about the educational issues that interested me in Haʻapai by relating them to the experiences of another Pacific Island community that may be facing similar, but also different, challenges. Given the widespread effects of climate change in the Pacific region and globally (Tukuitonga, 2017), I adopted a Case Study approach, to explore these in Port Vila and Haʻapai. Consequently, this research represents my hope of sharing different Indigenous (Pacific) ways of knowing and being in the face of climate change across the Moana. It is a small part of the 'vaevae manava' going on in Pacific communities through Pacific focused research.

Gaining access to the case study sites

I was granted approval from the relevant authorities in Tonga (Ministry of Education) and Vanuatu (VCC and Shefa Education Office) to conduct research in Haʻapai and Port Vila respectively (see Appendix A). The schools I chose to approach for participation in this research was limited by time as well as funding constraints and language. Less schools operate in Haʻapai in comparison to Port Vila. In Haʻapai, I chose a school where I had existing connections to facilitate entry and data collection in the given timeframe. In Port Vila, there are both English-speaking and French-speaking schools. However, since I did not have access

to a translator, I only visited the two English-speaking schools that were recommended by the Shefa Education Office.

Observance of cultural protocols in each case study site

Here in this passage, I will now briefly explain the key Tongan cultural values which combined to serve as a moral/ethical compass, thus, informing my research design and decisions made within each case study setting:

'Ofa Fakakalisitiane. 'Ofa is a Tongan cultural ideal translated as love or compassion (Vaioleti, 2006). Tatafu et al. (1997) used the term 'ofa fakakalisitiane to mean Christian love and claimed that "for Tongans, genuine love is most often interpreted in its Christian context. It is basically an altruistic love where the concern is for the welfare of others" (p. 67). Throughout my interactions with participants, I also attempted to apply this guiding principle from the Christian scriptures of "not looking to your own interests but each of you to the interests of the others" (Philippians 2:4, New International Version (NIV) Bible, 1978/2011). This principle became the *hama* (outrigger) for me on my research journey across the Moana, balancing my need to fulfil my research aims, while remaining attentive and responsive to my participants' concerns and interests. This, in turn, required a flexible approach to implementing my research design considering concerns participants raised (as discussed in following sections).

Vā. I conceptualised my relationships with participants and others involved in the research process in terms of the Tongan concept of vā, which (Ka'ili, 2005) described as the "social or relational space connecting people" (p. 92). Vaioleti (2006) proposed tauhi vā to be one of the recurring protocols of Pacific research in his interpretation that this "refers to what researchers do to maintain a good relationship between themselves, the participants and other stakeholders" (p 31). Later, Thaman (2008) suggested that vā becomes "a way of dissolving boundaries between insider/outsider …" (p. 465) and is context dependent. (Tapa'atoutai-Teisina 2020) agreeing that "Tongan ideals and values find their true meanings as they are related and practised in the light of tauhi vā [maintaining vā]" (p. 83).

Feveitokai'aki. Tapa'aptoutai-Teisina (2020) provides a compelling description of feveitokai'aki (given above) as the process of "giving mutual respect and honouring" (p. 83). This definition aligns with that given by Churchward (1959) who explained it as "to respect one another's feelings" (p. 183). As my elders reminded me, feveitokai'aki means reciprocity and has the word "toka'i" (respect) at its core. This implies caring for each other in a way that goes beyond just doing 'your part' in the relationship, but rather displays a willingness to go

out of your way for the sake of the other (M. Puloka & V. Puloka, personal communication, February, 2021).

Poto he anga. As Vaioleti (2006) has advised, "Each stage of any research is a potential ethical challenge. Poto helps us to recognise that we are part of a natural order, the natural way of being" (p. 30). I realized that each case study school, along with their corresponding education systems, had their own internal relationships, timetables and priorities that I needed to be sensitive to as a researcher. To that end, I had to exhibit the Tongan notion of poto, which Thaman (2008) described as "knowing what to do and doing it well in the context of Tongan culture (Thaman 1988)" (2008, p. 467). She added that people who are poto "understand their vaa [vā] and behave appropriately" (p. 467). In the different cultural settings of the case study sites central to this research, an understanding of poto required me to display what respect 'looked like' in each relationship, and to adapt my behaviour appropriately.

This adaptation to the cultural norms and nuances of both case study sites occurred with the support of cultural mentors in each place (for which I remain very thankful). In Haʻapai, I wish to acknowledge the support of Langilangi Vī (part of my kāinga – wider family), who helped me greatly to better understand and connect with community life. As described in more detail later (Chapter 6), she took me to visit the sites of environmental degradation that participating Haʻapai students had described in our talanoa. In Port Vila, I was guided by my friend and UC alumni, Naomay Jibe Tor, especially regarding adherence to local cultural protocols provided by VCC. The Tongan community and the Tevi family that hosted me in Port Vila also provided cultural insights to help me recognise the similarities and differences between the cultural norms of Port Vila and Haʻapai. These relationships also showed the importance of vā in cross-cultural learning.

Participant selection

As an outsider, it was a priority for me to build meaningful relationships with participants and school administration based on mutual trust and respect (feveitokaiʻaki). Therefore, while I had a research design in mind, I needed to remain flexible to meet the needs of the various research participants and their respective school administrators.

As a result, I first met with the principal of each school to discuss the research. Additionally, I presented each of them with an information letter and consent form (see Appendix B) which, (i) outlined the objectives and methodology of the research, and (ii) requested they select a teacher I could invite to participate in the research. Those teachers who agreed to participate were then presented with information letters and informed consent forms

(see Appendix C). When a teacher agreed to participate, they were next invited to identify students from their Form 4 (Year 10) science classes that I could also approach to participate in my study.

Those students were then presented with information letters for themselves and their parents/guardians, along with informed consent forms (see Appendix D). The information letters and consent forms for Haʻapai students and parents were translated into the Tongan language by Rev. Dr Tevita Tonga Mohenoa Puloka, a member of the Tonga Traditions Committee. This step was taken to ensure the ethical considerations I needed to adhere to were clearly communicated and understood by all stakeholders in this (Haʻapai) case study. All participants understood that their participation was voluntary, and they retained the right to withdraw from this research at any time without penalty (See Consent Form for Students in Tonga and Vanuatu: Appendix D).

All of this was consistent with the *Principles and Guidelines* of the UC Educational Research Human Ethics Committee (ERHEC) (2009). My research activities in each case study were, therefore, guided by the ERHEC principles and the cultural values and protocols discussed here and elsewhere in this chapter (Chapter 3). Other ethical considerations were given to each case study setting, and these are discussed in relation to the school and participant profiles provided below.

Case study one ethical considerations: Haʻapai, Kingdom of Tonga

School profile. Heilala College is a co-ed secondary school located in Lifuka, Haʻapai where both English and Tongan languages both serve as the mediums of instruction (see Chapter 5 for more detail). Given the limited number of schools in Lifuka, I have chosen not to specify which education system Heilala College is run by to protect the participants' anonymity.

Teacher profiles. Both of the participating teachers originate from outside of Haʻapai. I visited each of their science classes for classroom observations (described later in the Autoethnography section).

i. Tōnunga had more than 20 years' teaching experience in both government and church-operated schools. She had also completed undergraduate studies overseas and postgraduate studies in Tonga.
ii. Mana had only recently completed his teacher training at Tonga Institute of Education in Tongatapu. At the time of our talanoa, he was in his first year of teaching.

***Student profiles*.** Nine Year 10 students participated in this research and students were grouped together in terms of their class. All students identified themselves as being from various villages and islands within Ha‘apai (see maps provided in Figures 6.1- 6.2: Chapter 6). For manageability, I have listed the five students from Mana’s science class who participated as Group M. Their pseudonyms are listed here, below*:*

i. Fifita: Female from the village of Faleloa (Foa Island);
ii. Sally: Female from the village of Holopeka (Lifuka Island);
iii. ‘Alatini: Male from the village of Ha‘ato‘u (Lifuka Island);
iv. Viliami: Male from the village of Lotofoa (Foa Island);
v. Pita: Male from the island of ‘Uiha.

The four participating students from Tōnunga’s science class were, alternatively, labelled Group T. Their pseudonyms, in turn, are listed here:

i. Ishaani: Female from the village of Hihifo (Lifuka Island);
ii. Jasmine: Female from the capital, Pangai (Lifuka Island);
iii. Mary Bell: Female from the village of Koulo (Lifuka Island);
iv. James: Male from the island of Kotu.

In September 2015, I obtained copies of a series of Year 10 science assessments to review and consider in relation to my classroom observations and my talanoa with all participants. Copies of various formative and summative assignments were made to explore the culture of assessment in Heilala College. I also made copies of students’ notes taken during class. During a family trip to Ha‘apai from the 16th to 18th of November, 2015, I visited Heilala College again to obtain a copy of selected pages from the Year 10 science 2015 final examination. During this second trip I also obtained copies of two students’ notes they took during class, including notes from the climate change related unit, *Planet Earth and Beyond*.

Case study two ethical considerations: Selected schools in Port Vila, Vanuatu

***Nurture College (pseudonym*).** This is a co-ed secondary school run by a Christian church denomination. The medium of instruction is English, however, students are also required to study French as a compulsory subject in Year 10. I conducted three classroom observations, one pre-planned teacher talanoa session and two pre-planned student talanoa sessions. I also took a copy of the teaching timetable for Nurture College teachers.

Nurture College: Teacher profile (pseudonyms). Deborah was the Year 10 basic science teacher selected by the school’s administration team to participate in this study. She had completed undergraduate studies in a science field overseas. Unable to get a job in her field

when she returned to Vanuatu, Deborah gained employment at Nurture College as an untrained relief teacher. Although, at the time of our talanoa she was also studying towards a Graduate Certificate in Education.

Nurture College: Student profiles (pseudonyms). Three students were selected to participate from Deborah's Year 10 basic science class as listed below with their pseudonyms. Their places of origin are also provided:

i. Francis: Female, originally from Pango village in Efate Island;
ii. Anastasia: Female, originally from another Pacific country;
iii. George: Male, originally from Paama Island.

***Future College (pseudonym*).** This is a co-ed, state-run, secondary school. The medium of instruction is English. Like Nurture College, the students are required to study French as a compulsory subject in Year 10. I conducted two pre-planned teacher talanoa sessions and two pre-planned student talanoa sessions as well as three classroom observations in Rebecca's Year 10 basic science class. I also took copies of various assessments.

Future College: Teachers profiles (pseudonyms). Rebecca was selected by the school administration to participate in this study. She originated from Ambae Island in Vanuatu and had taught for over 10 years. Rebecca completed her teacher training in Port Vila at the Vanuatu Institute of Teacher Education. I observed three of Rebecca's Year 10 basic science classes. Rebecca also wished to invite her colleagues to participate in our talanoa sessions together. For the first talanoa session, we were joined by Cathy (from another Pacific Island country) and Barbara (from Vanuatu). For the next talanoa session, Cathy and Barbara were unavailable but we were joined by Gina (from another Pacific Island country).

Future College: Student profiles (pseudonyms). Three students were selected to participate from Rebecca's Year 10 basic science class, as listed below with their pseudonyms. Their places of origin are also provided:

i. Casillas: Male, originally from the island of Santo;
ii. Cattleya: Female, originally from the island of Santo;
iii. Bella: Female, whose father is from the island of Tanna and mother is from another Pacific Island country.

Other sites visited for collection of Vanuatu literature. In conjunction with adhering to the formal protocols of entering the research field in Port Vila, I visited the Shefa Education Office in Port Vila. Here, I obtained copies of the *basic science for Vanuatu Year 10 Teacher's Guide* (Vanuatu Ministry of Education, 1997a). I also obtained copies of other textbooks to help familiarize myself with the Vanuatu Education System.

- *Basic Science Earth Science Student's Book Year 9* (Vanuatu Ministry of Education, 1997a);remove all these references
- *Vanuatu Agricultural Syllabus Years 7 to 10* (Vanuatu Ministry of Education, 1997b);
- *The Human Body* (Obed, n.d.)

Since Vanuatu has national examinations in Year 10 (unlike Tonga), I also visited the Examination unit in Port Vila, where I obtained copies of the National Examination Year 10 basic science exam papers from 2010 – 2013, as well as the National Examination Year 10 social science exam paper for 2011 to help me to better understand the culture of assessment.

In each case study, three forms of data were primarily collected. Audio recordings from talanoa sessions which were later transcribed, notes from classroom observations as well as documents from the field such as student notebooks, syllabi, copies of assessments and teacher timetables. The analysis of the talanoa is described in the section below. However, it is worth noting that the documents and notes from the observations were analysed using the themes which emerged from the talanoa with participants. In other words, as the themes from talanoa were being crafted, I checked the documents and notes to see what insights could be gleaned from these to enrich the thematic analysis of the talanoa. This became particularly important in the themes regarding marginalisation of Indigenous language and culture where documents provided insight on how education authorities in each context approached these issues.

Talanoa

Talanoa is a decolonising methodology based on Pacific values and constitutes one of the most widely used Pacific research methodologies (Suaalii-Sauni & Fulu-Aiolupotea, 2014). From a Tongan perspective, talanoa literally means to inform, tell or relate (tala) about anything or nothing in particular (noa) (Vaioleti, 2006). A prominent academic, Vaioleti (2006), has explained its reciprocal nature as follows:

> An open technique is employed, where the precise nature of questions has not been determined in advance, but will depend on the way in which the Talanoa develops. The Talanoa will end when it loses its *mālie* or starts to revisit areas covered already, since then it is probable that no more new points will be added to those that have been co-constructed." (p 26)

Vaioleti (2006) cites the work of Manu'atu (2002) in his description of mālie, who elsewhere explained that "talanoa can become an experience that is mālie when it draws upon the passion, knowledge, and nuances of the culture and moves the heart, mind, and soul of the participants to a realm of deeper understanding, beyond what is experienced" (Manu'atu, 2003, Tongan Language and Culture section, para. 2).

From the outset, I found that the talanoa approach employed during Case Study One in Haʻapai had positioned me well to listen to the important concepts that participants preferred to use when describing environmental issues or teaching practices. This reciprocal process, furthermore, helped me to develop further questions based on the concepts they introduced in our talanoa. In relation to Port Vila, I recognised that talanoa, as a research method, has particular meanings in a Tongan context. These may not be shared in culturally diverse Vanuatu.

Hence, it is worth noting that Sanga et al. (2020) has described tok stori as a "form of dialogical engagement" (p. 1), which is similar to talanoa in its relational focus. Storian was also a method used for research in Vanuatu by Warrick (2009) taken to mean opportunistic discussions aimed at building relationships with participants, comparable to Talanoa. Sanga et al., (2020) described tok stori as being comparable to talanoa (drawing on the work of Tongan authors such as Seuʻula Johansson-Fua and Timote Vaioleti who I have also considered) and the yarning, used among Australian Indigenous peoples. With these similarities to other dialogical approaches, I decided to use a modified version of talanoa in Port Vila, guided by my cultural advisers there.

Openness and flexibility, between researcher and participants during a talanoa session, is a product of trust grounded in 'cultural connectedness' (Prescott 2008, as cited in Mafi, 2018, p. 27) . In a Tongan context like Haʻapai, it has been my experience that this sort of cultural connectedness is best facilitated by Tongan values such as these listed here by Vaioleti (2006), including: ʻofa (love), fakaʻapaʻapa (respect) and poto he anga (knowing what to do and doing it well). However, Faʻavae (2018) highlighted the need for deconstruction and reconstruction of talanoa for his use of it in the Tongan diaspora. I too believed deconstruction and reconstruction was required with the use of talanoa in any context, particularly when collecting information in Port Vila schools. Hence my reconstructed use of talanoa as a Tongan teacher-researcher navigating different cultural settings is described below.

Description and analysis of talanoa

In Haʻapai, I met with students in Group M and Group T twice as separate groups for pre-planned talanoa sessions. I also met with Tōnunga and Mana together for two pre-planned talanoa sessions. All talanoa sessions were held in one of the classrooms at Heilala College during or directly after school hours, depending on participants' availability. I remained sensitive to the time commitments of participants and showed appreciation for their time by sharing food or gifts with them as appropriate.

In Port Vila, I had planned to meet with the selected teachers (Deborah from Nurture College and Rebecca from Future College) together. They, however, preferred to conduct their talanoa sessions separately, on their own campuses. In accordance with the value of feveitokai'aki (mutual respect and honouring), I therefore changed my research design to match their preferences. Rebecca, for example, preferred to have two talanoa sessions but invited colleagues to join in, wanting to ensure I had the information I needed. In Future College, one day a week involved less classroom work. As a result, Future College student participants suggested we talanoa during that time instead of at lunchtime and so we were able to have a more extended talanoa. Although this resulted in different ways of collecting data at each school, these decisions were made in light of our vā and the value of feveitokai'aki (respect) and poto he anga (knowing what to do and doing it well). All of this helped me to be sensitive and aware as to what would make participants feel most at ease.

Each talanoa session was audio-recorded. Once I had left each school site, I transcribed the audio recordings verbatim in Tongan for Case Study One and in English for Case Study Two. I decided not to translate the whole transcripts for Case Study One into English, for reasons similar to Palefau (2005), who also conducted interviews in the Tongan language for his doctoral thesis. He too noted that:

> I found it very inconvenient to work with two languages so I left all transcriptions in Tongan. I read the transcription several times to familiarise myself with what interviewees had said and to decide what they meant by their comments. Only the passage that I needed for quotation was then translated into English (Palefau 2005, p. 159).

Encouraged by the work of Palefau (2005), I produced translations of all the Tongan language quotes presented in this thesis, and had these translations verified by Dr 'Ana Taufe'ulungaki in Tonga, unless otherwise stated.

Another benefit of having two talanoa sessions with each participant/group of participants was that this allowed me to revisit themes that had been discussed in previous sessions. Since I spent periods of time at each school outside the talanoa sessions, this gave me time to build vā and demonstrate the value of feveitokai'aki (described previously) with participants. Subsequently, the participants themselves often checked whether I needed any help or additional information.

This growing trust between the participants and me led to two unplanned talanoa sessions as well which were audio recorded. For example, in Ha'apai, two students (Ishaani and Jasmine) came together to look for me at their school to offer additional comments to their

prior answers. They also asked if I had any more questions and this resulted in another brief talanoa session. Also, in Nurture College in Port Vila, I bumped into participating students (Anastasia and Francis) while waiting to speak to a staff member. We engaged in talanoa spontaneously, to confirm certain details we had previously discussed and wished to revisit.

A key strength of the talanoa process is, consequently, its unstructured nature which can allow space and time for the gradual opening of new perspectives amongst participants and researcher, alike (Halapua, 2008). Participants respond to the knowledge shared by others in the talanoa, already lending the talanoa process to generating themes explored through reciprocal storying. During our talanoa, additional questions arose which I had not pre-empted. These questions arose as both participants revealed more about their lived-world experiences through story telling. These questions have subsequently served to inform data analysis in ways that align with descriptions of unstructured qualitative research methods shared by Corbin and Strauss (2008). Below, I provide an example of how this took place in my research from talanoa with Ha‘apai students.

I had asked Ha‘apai students, “Do you notice any changes in the environment of your village or island?” Students in Group T had responded to this by also discussing changes following TC Ian, something I had planned to ask them about later. Instead of another question about changes in the environment after TC Ian, I decided to change my question and instead I asked them about their family life before and after the Cyclone. The students’ answers highlighted the role of kāinga (wider family) in recovery and linked with other explanations of environmental change. This helped me to identify the recurring theme in our talanoa of the Link between Social and Environmental Realities (discussed further in Chapter 6).

This example demonstrates the fluid nature of talanoa given by Vaioleti (2006) who suggested that “when to speak and what one says depends upon what the other has to say” (Vaioleti, 2006, p. 26). In this doctoral research, I have found that the thematic analysis of data begins in the talanoa itself and is a process the researcher continues in the writing stages of research. In Vanuatu, a not too dissimilar process evolved with teachers and students.

How were my research themes developed? As indicated above, the recurring themes were generated during the talanoa and later, by relistening to audio recordings and active reading of the transcripts (described later). All of this necessitated iterative writing cycles, which were refined through ongoing conversations with my supervisors and critical kāinga that served as a verification process. According to Braun and Clarke (2006), “a theme captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set” (p. 82).

I then made a list of what I termed ‘movements’ within the talanoa. The purpose of these movements was mainly to manage data, allowing me to see the differences and similarities between talanoa sessions and identify possible themes recurring across case studies. Viewing our talanoa sessions as movements, such as in a drama (cite Reissman on Narrative Analysis) allowed me to handle fluid conversations, mindful of the vā (relationships) pulsing through them, but constrained by the static nature of written transcripts. The first three movements of the first teacher talanoa at Future College, for example, produced the following themes: (i) Personal Pathways to Teaching: (ii) Teacher Involvement in Extra-curricular Environmental Club and; (iii) Motivating Students to Learn Science.

Identifying and listing the movements in each talanoa helped me identify what Braun and Clarke (2006) refer to as the “keyness’ of a theme”. They argued that “the ‘keyness’ of a theme is not necessarily dependent on quantifiable measures – but rather on whether it captures something important in relation to the overall research question” (Braun & Clarke 2006, p. 82). However, this identification of ‘keyness’ is also impacted by the researchers’ own personal life experiences. I resonated with Reissman’s (2000) description of how her own personal life experiences unfolding during her research impacted her interpretation of her qualitative research data on childlessness among women in Kerala, India. She had conducted interviews with women at that time when she was recently divorced and hence explained:

> During the interviews, we encouraged women to give extended accounts of their situations, including the reactions of others: husband, his family, her family, the neighbors … Responsibility for the analysis is mine, accomplished over an extended period beginning in India, continuing (and changing) as I returned to the united States … and also decentered my notions of autonomous selfhood. Indian women did not act alone … Husbands entered my analytic field, particularly actions to support and protect wives from stigma (the shift was coterminous with my remarriage). (Reissman 2000, pp. 116-117)

In the same way that Reissman’s analysis shifted with her own life experience, my move back to Tonga, and back into the classroom as a teacher in 2020, shifted my own analysis of the data. I was, once again, immersed in the daily life of Tonga. As I chatted with a farming family who sold watermelons across the road or visited my cousin’s pā (traditional fish trap), I felt the unsettling dissonance between these experiences and the science I was paid to teach in school. These realizations, unfolding over time as I was re-immersed in a Tongan setting, greatly shaped my data analysis. As a result, I felt I needed to explicitly incorporate autoethnography into my research design.

Autoethnography

Autoethnography is a research method increasingly used in social science research (Chang, 2016). It is described by Adams et al. (2017) as follows:

> Autoethnography is a research method that uses personal experience ("auto") to describe and interpret ("graphy") cultural texts, experiences, beliefs, and practices ("ethno"). Autoethnographers believe that personal experience is infused with political/cultural norms and expectations, and they engage in rigorous self-reflection—typically referred to as "reflexivity"—in order to identify and interrogate the intersections between the self and social life." (p. 1)

The vast socio-cultural differences in both case study settings (contexts), and the time required to culturally orientate myself in each setting, I was challenged to critically reflect on my position as a young Tongan woman and teacher/researcher. I further needed to be transparent about my explicit and implicit cultural biases, so I kept an analytical memo intermittently throughout the research process. I had also included Observer's Comments in some of my classroom observation notes, reflecting on how my experiences made me feel or think of. These were important tools to help me practise reflexivity.

This was important because I required tools to meaningfully compare what participants were saying about climate change and schooling in two different contexts. After consultation with my supervisors, I realised that using an auto-ethnographic approach would help me to "make the familiar strange" (Sikes, 2006 as cited in Mannay, 2010, p. 94). Moreover, I soon began to see the "strange" (read unfamiliar) in Vanuatu as the familiar in Tonga, which shifted my appraisal of the Tongan schooling system.

The value of this approach, for example, became very evident to me when I critically reflected upon my initial reluctance to use decolonising theories in relation to my Tongan case study. As a result, I felt I would somehow be a traitor to our proud (Tongan) history of independence by using theoretical concepts like decolonization. When I visited the capital of Vanuatu (colonised by the English and French), I soon noticed that the schools in Port Vila felt strangely familiar. They felt like the schools I had attended in the capital of Tonga during my childhood and they felt like the school I had recently researched in Haʻapai.

Practicing reflexivity in the context of another Pacific community, caused me to reappraise my previously 'taken for granted' assumptions about the scope of science education in Pacific community settings. Moreover, the autoethnographical nature of my research has now left me questioning whose values are most influential in shaping schooling in the Pacific and why? I could relate to the assertion of Thaman (2003) that "education is not culture-free"

(p. 7). This led to more questions, such as, why does Tonga, never formally colonised, continue to priviledge foreign languages in our assessments, like Vanuatu which was colonised? This questioning caused me to move beyond what I had conceived as the boundaries of science education research to consider the role of communities' languages and cultures in learning science, as demonstrated throughout Chapters 5 to 8.

Since qualitative research has reflexivity as a core value, it allows deliberate consideration of the researcher's beliefs, assumptions, history and experiences, "makes explicit the researcher's contribution to the interpretive process" (Liamputtong, 2020, p. 1898d). This aligns with Indigenous research methods developed to reflect the ontologies and epistemologies of Indigenous peoples, often as the 'other' in research (Smith, (1999). Adopting an autoethnographic stance builds on this reflexivity, centralising it in the research, as suggested here:

> Ethnography is not simply a collection of the exotic "other;" it is reflective of our own lives and cultural practices even when discussing another culture. Autoethnography involves the use of cultural richness for self-reflection and understanding the nature of the encounter … Other authors take their personal accounts as the heart of their research, where they use cultural reflexivity to "bend back on self and look more deeply at self-other interactions" (Ellis & Bochner, 2000, p. 740). The interaction between the researcher and his or her subject(s) is highlighted through personalized narrative, written in the first person, and accompanied by personal anecdotes. (Tomaselli et al., 2008, pp. 348-349)

In my research, I was inspired by other decolonizing authors who made visible, the moral, spiritual, cultural and familial questions that arise during a research journey and communicate these in ways that touch the heart, particularly through the use of poetry. During my research journey I chose to return home to Tonga. Here I would complete the writing of my thesis with the support of my husband and kāinga who also took the role of 'critical friends' during the final analysis and writing stages. This homecoming would set the stage for an indigenising of my consciousness (Tuhiwai Smith, 2021).

As themes from talanoa – including those of marginalisation of Indigenous languages and cultures – emerged, I experienced pain. Pain, because I completed this research as a teacher and what I was paid to do was exactly what I was critiquing. As Krog et al. (2008) reminded me, "pain first resists expression and then destroys the capacity for speech" (p. 537). Rather than ignore its growing presence in me throughout this research, autoethnography became a way of resisting the pain-induced writer's block as it welcomed poetry which I used to explore the tensions of being a teacher – researcher. Inspired by the poetry of other academics such as

Konai Helu Thaman (2001), Mohenoa Puloka (2017) and David Fa‘avae (2018), poetry became a means of reflexivity in my research.

University of Canterbury: Ethical considerations

University of Canterbury ethical research guidelines (ERHEC)

This research project was approved by the UC ERHEC, which required my preparation and ERHEC's evaluation of: (i) all my participant information sheets and consent forms (See Appendices B-D) (ii) proposal. The letters indicating approval for Case Study One and Case Study Two by the UC ERHEC are provided in Appendix F.

To ensure adherence to local policy regarding research practice, ethical approval was also sought from local governing authorities, namely the Tongan Government and the VCC (See Appendix A). Although, at the time of writing, I am an employee of the Tongan Ministry of Education, the views presented in this thesis are not representative of my employer. This engagement with officialdom in both countries helped provide accountability mechanisms which, in turn, helped me to consider how I could best protect the identities of the participating schools, and participating teachers and students. In 2018, I sent a summary of preliminary research findings to the VCC.

This was a significant challenge in Ha‘apai, given the fewer number of schools in Lifuka. Therefore, I left out some key details such as the schooling system that Heilala College (pseudonym) is affiliated to. I also have elected to withhold details about the teacher participants which would make them easy to identify. In Vanuatu, I took similar steps to prevent participants being easily identifiable, given the relatively small size of the Pacific Islands communities within Port Vila. As Appendices B – D also indicate, I decided to protect school and participant identities through the strategic use of pseudonyms and by not providing other people with access to the transcripts to others.

However, it should be noted that my vow to preserve participant anonymity clashes with a Tongan (and wider Pacific) value of publicly acknowledging and thanking those who helped me succeed in any endeavour. Writing this thesis subsequently required me to navigate a continual tension of how I could present knowledge co-constructed with others through talanoa, when ERHEC protocols determined I must not name participants or allow them to be identified through my writing.

Even though this research may be completed, as a Tongan researcher, I remain bound to the process of feveitokai‘aki which entails "giving mutual respect and honouring" (Tapa‘atoutai-Teisina, 2020, p. 83) to the participants. Efforts to do this are acts of resistance

against aligning my research with the notion of Trading the Other which Linda Tuhiwai Smith (2021) described:

> Trading the Other is a vast industry based on the positional superiority and advantages gained under imperialism. It is concerned more with ideas, language, knowledge, images, beliefs and fantasies than any other industry. Trading the Other deeply, intimately, defines Western thinking and identity. As a trade, it has no concern for the peoples who originally produced the ideas or images, or with how and why they produced those ways of knowing (p. 103).

Conclusion

This chapter has discussed the methods, approaches and values adopted to address research questions central to this thesis. A case study approach was employed within a metaphor used of a journey across the Moana, seeking to explore namely, (i) how Year 10 students in Haʻapai and Port Vila conceptualise local environmental issues and (ii) how Year 10 science teachers in Haʻapai and Port Vila frame local environmental issues. This chapter provided literature about talanoa as a research method as well as details of how I used talanoa with teacher and student participants in both case studies to explore research questions. A desire to reflect on my personal growth as a Tongan teacher-researcher was done using autoethnography. I have also described the process I took to follow UC ERHEC guidelines to protect participants in the study. Key to this process was consideration of the differences that existed between (and within) each case study context. In the following chapter, Chapter 4, I provide contextual background on both Haʻapai and Port Vila.

Chapter 4 : Research Context

Introduction

‘Epeli Hau‘ofa (1994) was renowned for declaring that:

> There is a world of difference between viewing the Pacific as "islands in a far sea" and as "a sea of islands." The first emphasises dry surfaces in a vast ocean far from the centers of power. Focusing in this way stresses the smallness and remoteness of the islands. The second is a more holistic perspective in which things are seen in the totality of their relationships. (pp. 152 - 153)

The purpose of this section is to provide context for the findings of this research. In doing so I emphasise the relationships between various actors in evaluating the state of education and environment in the research contexts, the island of Lifuka located in Ha‘apai Island Group in the Kingdom of Tonga and the Port Vila municipality in the Republic of Vanuatu (see Figure 4.1). Before I proceed to discuss these key contextual factors, I will reiterate my connections to both case study settings to provide further transparency in relation to my own positionality as a researcher during this study.

Personal positioning in relation to each case study community

Like any researcher, I am an “extension of a community” (Chang, 2016, p. 26) and this influences my conceptualisation of the research project. For example, as part of the Pacific student community at UC, I was greatly helped by fellow students from Vanuatu who kindly supported me in the design and development of this research journey – acting as critical friends/cultural guides. Tuhiwai Smith (2021) has emphasised the importance of being upfront about one’s identity when researching in Indigenous communities. As a Tonga teacher-researcher, I also acknowledge my “sociospatial connection” to Ha‘apai and the people of Ha‘apai (Ka‘ili, 2005, p. 85). Although I grew up in Tongatapu, my great-grandfather is originally from Faleloa village in the island of Foa in Ha‘apai. My mother is from the United States of America and English was always the language of our home as well as the schools and churches we attended, while I learnt Tongan in other settings.

My diverse cultural heritage has meant I am continually learning the art of edgewalking, which is described as:

> “… embracing the complexity of culture and identity to walk the edge between multiple worlds and positions … the edgewalker may experience intense pain as they attempt to remain true to themselves rather than taking the easy way out and becoming a part of the whole.” (Krebs, 1999 as cited in Beals et al., 2020, p. 5).

This edgewalking was also applied to my research that I completed while teaching in a government-run secondary school in Tonga, known for enforcing English-only in school and its focus on examinations. This positionality strongly influenced my conceptualisation of schooling in each case study, the questions I had about it and how I approached these questions and tensions I encountered, choosing to use talanoa and autoethnography for reasons discussed in Chapter 3.

Throughout this research project, I was also reminded of the ancient links which exist between, Vanuatu and Tonga (see map presented in Figure 4.1, below). There is evidence to suggest ancient links between Vanuatu and Tonga identified through archaeological remains of the Lapita culture (Marshall et al., 2005) as well as evidence from genetic studies (Lipson et al., 2020). A traditional practice still shared in Tonga and Vanuatu is the consumption of kava, a drink made from the crushed roots of the plant *Piper methysticum* (Aporosa, 2019).

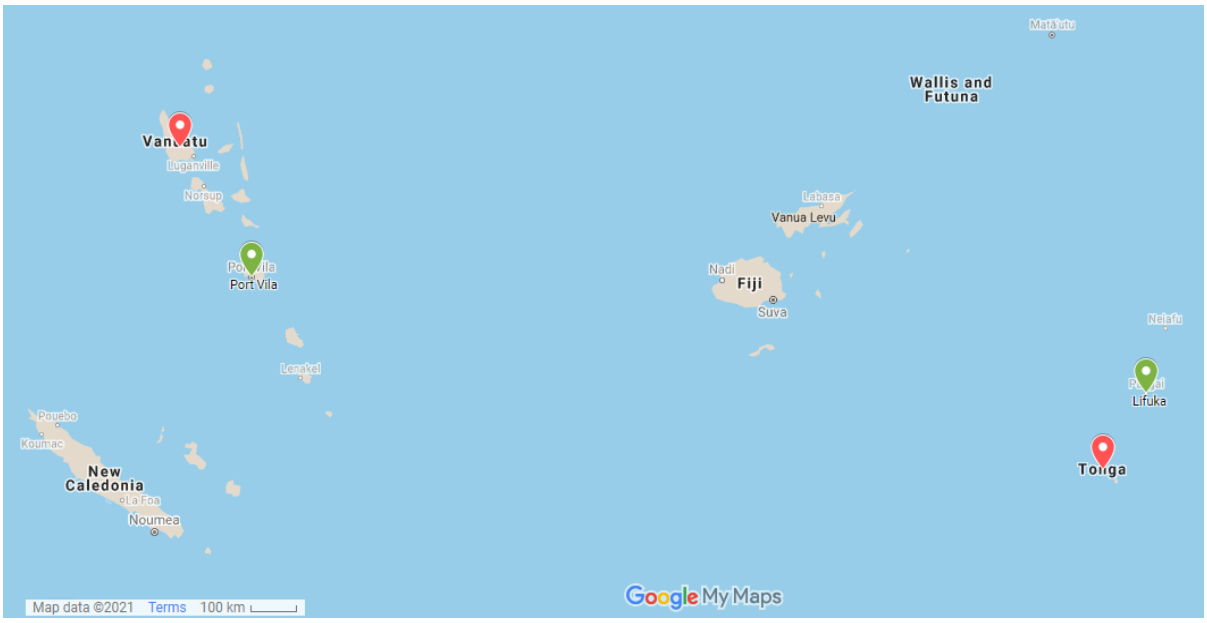

Figure 4.1*: Map showing the location of Vanuatu and Tonga in the South Pacific Ocean. Map adapted from Google Maps (Google, n.d.-e).*

Contextual background for Case Study One: Ha‘apai, Kingdom of Tonga

In this section, an overview of the basic description of Ha‘apai as an island group in Tonga is given followed by a discussion of the development of schooling in Ha‘apai. The Kingdom of Tonga consists of 172 islands, with a total land area of 747 km^2 arranged into four groups; Tongatapu, Ha‘apai, Vava‘u and the two Niuas (Mailau et al., 2007). Ha‘apai is located in the centre of the Kingdom of Tonga (see Figure 4.1, above) and although its total land mass is only 119 km^2 (Mailau et al., 2007), it is spread over 10,000 km^2 of ocean (Ceccarelli et al.,

2017). In 2016, the population of Haʻapai was 6125 (TSD, 2019). The first case study took place in Lifuka (the main island of Haʻapai), which was reported to have a population of 2205 (TSD, 2017). In modern times, Haʻapai has experienced a high rate of outward migration, both to the main island of Tongatapu (some 170 km of ocean away), and overseas to countries like Aotearoa New Zealand, Australia and the united States of America (Small & Dixon, 2004 in Tonga, 2020).

The culture of the people of Haʻapai can be considered in light of the challenges they face in their lived environment. TC Ian hit Haʻapai in January 2014 and caused extensive damage to agriculture and housing (Magee et al., 2016). Lifuka faces various climate change challenges as a result of rapid coastal erosion and inundation from rising sea levels (SPC, 2014). Access to freshwater, for example, is an ongoing problem, with Haʻapai having lower than normal rainfall during dry season. This can lead to drought conditions if prolonged (Mailau et al., 2007). However, the resilience of Haʻapai people is acknowledged in the face of the environmental challenges they face and is even celebrated in the well known song *Hiva Afaa ʻa Vaea* (Cyclone Song of Vaea), composed by the late Queen Salote Tupou III (Queen Sālote Tupou III, 2004).

However, Haʻapai is also blessed with a variety of coral reefs and in 1997 the Government of Tonga declared the Haʻapai group to be a conservation area, noting its high productivity due to its coral reefs and areas of upwelling (Ceccarelli et al., 2017). Special Marine Areas were also established in some communities in Haʻapai such as Felemea (Tupou et al., 2016). Especially relevant to this thesis is the past research done on the biodiversity in Haʻapai as described by Tonga Department of Environment (2004, p. 3):

> Thaman et. al. (1996), stated that for the Haʻapai Group, biodiversity conservation is seen as synonymous with sustainable use. For the people of Haʻapai, "biodiversity" is not just a matter of scientific, economic (in monetary terms), recreational or ecological value. It is a capital inheritance that has been passed on, relatively intact or in some cases enhanced, by past generations to current generations. Biodiversity is not income to be spent or destroyed … Thaman et al., (1996) further argued … if traditional sustainable management practices, and the knowledge and language (e.g., plant and animal names and language associated with farming and fishing techniques, seasons, tides, etc.) are not maintained or strengthened, that all other modern development (e.g., business, education, tourism, handcraft and industry, etc.) may fail in the long term.

The link of biodiversity and ecology and human cultures is explored throughout this thesis. Useful in this endeavour is the concept of fonua which means "land and its people and their on-going relationships" (Tuʻitahi, 2005, p. 19). Fonua also holds spiritual or religious

connotations. Tukufonua ki Langi was an event that occurred on the 20th of November, 1839 (T. Havea, 2020) in the island group of Vava‘u in Tonga when our first Christian monarch, Tupou I dedicated the fonua to the Christian God to protect, rather than give his country over to be ruled by the colonial powers of the day. I am interested to explore how these cultural understandings of fonua are engaged with by participants in considering local environmental issues.

Schooling (ako) in Ha‘apai

I begin this section with an acknowledgement of an oft repeated Tongan saying that home is the first school, or in Tongan, “ko e ‘uluaki ‘apiako, ko ‘api” (Vakapuna, 2019, p. 4). This exemplifies the Tongan notion of learning, or ako, described by Johansson-Fua (2008):

> It is a form of learning that is neither bounded by classrooms, age nor by subject field. Ako in the true sense of the Tongan word refers to all kinds of learning throughout one’s life as such reflecting a life-long approach to learning. Additionally, ako is not only the acquisition of ‘ilo (knowledge) but also the poto‘i (demonstration) of the ‘ilo in given context where it proves meaningful, worthwhile and thereby useful. (p. 1)

Families had been responsible for teaching their children the knowledge and skills needed to ako to fulfil their duties in society, prior to European arrival in Tonga (Koloto, 1998). As previously discussed in the literature review (Chapter Two), ako is the Tongan word for learning and is the word used to describe schooling today. In Tonga, ako of TKS also still occurs through apprenticeship, as, for example, “learning to weave is a process of sharing skills with elderly and experienced weavers” (Palefau, 2005, p. 292). These skills were identified to be linked with sustainable livelihoods (mo‘ui fakapotopoto) as found by Johansson-Fua et al. (2007) who found that “mo’ui fakapotopoto does not necessarily equate formal qualifications but rather adheres to set cultural competence criteria that are in line with core Tongan values” (p. 12).

Examples given of those with sustainable livelihoods included farmers who follow Tongan knowledge of weather patterns, weavers who are finding new ways of using their knowledge and a carver seeking to share his traditional knowledge with others who have left school. This is shared to emphasise the resilience of the knowledge base to the introduction of schooling by the missionaries which undervalued traditional Tongan knowledge and skills (Koloto, 1998, p. 124).

In many secondary schools in Tonga extra classes are offered to students through private tutoring and/or by the students’ teachers (‘Otunuku et al., 2017). Schooling and preparation for high stakes assessments extend the amount of time students in Ha‘apai (and

elsewhere in Tonga) may spend away from the home. Schooling removes children and youth from their traditional learning contexts for a significant shift in the provision of education from kāinga settings to distant school buildings, has also seen significant changes in pedagogy. As Thaman (2009) has argued, Indigenous (Pacific) peoples' ways of learning traditionally included actively learning by observation, imitation and trial and error. I will now briefly discuss how the arrival of Europeans in Tonga led to the development of schools we have today in Tonga, focusing particularly on the different education providers involved who have replaced the learning of traditional knowledge and skills of children from kāinga in the environment with learning from paid faiako (teachers) in classrooms.

At the time of European exploration and missionisation in the Pacific, Lifuka played a significant role in shaping early European and Tongan interactions. In 1777, Lifuka was named "the Friendly Island" (Cummins, 1972, p. 7) by Captain James Cook, a name which was later applied to the whole of Tonga (Cummins, 1972). In 1806 the English ship Port au Prince landed in Lifuka and was attacked by Tongans (Mariner & Martin, 1820). The site of the sunken ship is now a tourist attraction today. In February, 1830, the English missionary John Thomas and his wife set up a schools, with the support of King Siaosi Tupou I, in Lifuka where pupils learned to read and write and were instructed in the newly introduced Christian religion through catechism (Thomas, 2013). Another known site in Lifuka is the grave of Tevita Tonga Mohenoa who was first head tutor of Tupou College, a secondary school in Tongatapu set up by Wesleyan missionary Dr. James Egan Moulton, in 1866 (Lātū, 2011).

Although Moulton had originally come to Tonga at King Tupou I's request to set up a College, King Tupou I's relationship with Moulton and the Wesleyan missionaries soured at the King's resistance to foreign religious control and his eventual break away from the Australian parent church, starting the Free Church in 1885 (Niumeitolu, 2007). Amidst these tensions, the first Government secondary school, Tonga College, 'Atele was established in 1881 (Tonga College 'Atele, 2013). While the details and political effects of this split on society are discussed elsewhere (see Cummins 1972; Lātū, 2011), I wish to draw attention to the development of schooling after this period. Primary school education had been made compulsory through the first Education Act in 1876 and various church denominations continued to establish secondary schools in Tonga, such as the Catholic secondary school in 1886 (Palefau, 2005).

The secondary school entrance examinations taken after primary school is a high stakes exam and the highest scoring students gain access to certain government schools while the private schools accept lower scoring students (Wise, 2019). It is of interest to me that

examinations have played a significant role in shaping the Tongan society even during the reign of Queen Sālote Tupou III (1918 - 1965), who was supportive of education in Tonga, although education had an interesting effect on the hierarchical Tongan society:

> Passing examinations was a conclusive way of proving superiority, quite apart from the tangible rewards that could follow. The school whose pupil won first place shared in his glory, as did his kāinga. Sālote and Tungī were disappointed that the sons of high ranking chiefs did not avail themselves of the opportunities for further education in order to better equip them to be future leaders of Tonga … Education was widely valued at every level except the most privileged as a means of acquiring status that could not be requisitioned (Wood-Ellem, 1981, pp. 189 - 190).

Success in school in Tonga is still seen to be a means of getting paid employment to fulfil cultural fatongia (obligations), thus even seemingly "meaningless subjects, were important in so far as they provided the knowledge (ilo) necessary for becoming successful in school" (Thaman, 1992a, p. 9). I wonder how this may impact teacher-student relationships in learning, given Freire's concern about the narrative nature of decontextualised education which is based on "the sonority of words [used by the teacher], not their transforming power" (Freire, 1970/2005, p. 71).

In the 1960s, each school system in Tonga used various curriculums developed overseas and locally (Palefau, 2005). I have discussed the use of foreign examinations in Tonga such as the New Zealand School Certificate and the development of regional examinations such as the Pacific Secondary School Certificate and then national examinations in the Literature Review (Chapter 2). Notably in recent years, foreign aid from the People's Republic of China has played a significant role in funding scholarships and construction projects, through grants and loans, including that of the only government high school in Lifuka, Ha'apai High School (Hanson & Fifita, 2011; Wang, 2018). Before the opening of the government school in Lifuka, Ha'apai, the only option available to continue schooling in Ha'apai after primary education was attending secondary schools run by various church denominations (Bender, 2009).

Contextual background for Case Study Two: Port Vila, Vanuatu

In this section, an overview of the basic geographical features of Vanuatu is described followed by a discussion on the development of schooling in this Pacific context. The Republic of Vanuatu is comprised of 80 islands arranged in a distinctive Y-shape with more than 1200 km between the northern-most and southern-most islands (Sardos et al., 2016). The total population of Vanuatu in 2016 was 272,459 (Vanuatu National Statistics Office, 2017), which is significantly larger than that of Tonga. The Indigenous Ni-Vanuatu make up 94% of the population, however, the rural population of Vanuatu is almost entirely Ni-Vanuatu

(Lumelume, 2007). The islands of Vanuatu are divided into six provinces, which from the North to South include: Torba, Sanma, Penama, Malampa, Shefa and Tafea provinces (Vanuatu National Statistics Office, 2017). Port Vila is part of Shefa province and is a metropolitan centre and the capital of Vanuatu, with a population of 50,944 in 2016 (Vanuatu National Statistics Office, 2017).

As a secondary school student in Tonga, I heard about Port Vila because one of the three major campuses of the University of the South Pacific (USP) is there. This is the Emalus campus, host of the School of Law and the Pacific Languages unit (Naidu, 2019) which Tongan students often attend. During my research trip to Port Vila, I visited the Emalus campus for a Tongan community monthly church service where I met students from Tonga, showing how tertiary education opportunities offered in Port Vila, influences schooling in Tonga.

Port Vila is one of three urban centres in Vanuatu, the other two being Luganville on the island of Santo, and Lenakel on the island of Tanna (Warsal, 2009). The Greater Port Vila Area (including areas beyond the municipal boundary such as Mele and Pango) covers 24.3 km^2 of land and rapid urbanisation here is putting pressure on ecosystem services, such as those from the water catchment and lagoons (McEvoy et al., 2017). Land ownership in Efate island, where Port Vila is located, is a contentious issue, since some tribes here had sold their land to foreigners, resulting in the potential for "serious destabilisation in the long run" (Ratuva, 2014, p. 47). Also, peri-urban communities of Blacksands and Manples in the Greater Port Vila area, sit on customary land but the residents are not customary owners, having settled there with various agreements based on introduced and customary systems (Day & Bamforth, 2020).

Vanuatu's economy has been described as ""highly dualistic", with a modern urban economy in the two main cities, Port Vila and Luganville, and a subsistence economy in the rest of the archipelago" (Sardos et al., 2016, p. 723). Elsewhere, Regenvanu (2010) has argued that the traditional economy is not a hindrance to development, but a key to resilience in the face of climate change. He also problematised schooling in Vanuatu, stating that, "formal schooling at primary and secondary levels actively contributes to the loss of the knowledge and skills that allow an individual to function as a member of their own community and a part of the traditional economy" (Regenvanu 2010, p. 33). In Vanuatu, as well as other Pacific nations, the kinship system (known as wantok in Vanuatu) provides social protection even to those who have moved to urban Port Vila where they may actively engage in both paid employment and collective labour.

Rapid growth of Port Vila and a lack of a master plan for infrastructure and land use have, amongst other things, led to the "ad-hoc growth, land speculation, deforestation, weak

coastal management systems, and significant inadequacies in the provision of basic services, especially drainage and sanitation infrastructure" (Department of Environmental Protection and Conservation of the Government of Vanuatu, 2011, p. 1). Moreover, the coastline of Port Vila, is a place of long-contested values expressed through development projects which have included: the development of rock revetment structures to combat coastal erosion; a portside building project to welcome cruise ship tourists; the building of Fatumaru Bay Park (at a beach popular with locals); and the construction of sea wall panels to combat storm surges (Vanuatu Project Management Unit, 2016).

Furthermore, Vanuatu is a country always at risk of natural disasters given its geographic positioning. In summary, it faces threats of tsunami and earthquakes along with sea-level rise (Secretariat of Pacific Regional Environmental Program (SPREP), 2017). Research indicates that Vanuatu's islands are either composed of raised limestone and/or volcanic origins and water is collected, sourced from the ground through wells and can be supplied to coastal areas by rivers and creeks (Nath et al., 2006). Rainfall is consequently affected by El Niño and the Southern Oscillation cycles in which an El Niño season can also lead to drought conditions and can be difficult to model climate change projections on this (SPREP, 2017).

In a land and seascape where multiple risks are posed to the communities, ancient societies developed resilience through socio-cultural practices which encouraged the production of a surplus of food, social co-operation, change in food consumption during times of famine and other strategies (Campbell 2006, 2009, as cited in Sardos et al., 2016). This, in turn, contributed to a diverse network of durable Indigenous social systems that typify community resilience through their "ability … to absorb perturbations without changing … structure" (Holling, 2003 as cited in Sardos et al., 2016, p. 722). In these times of changing climate patterns and cultural trends, this research was designed specifically to explore how science educationin both case study settings positions teachers and students alike to critically engage with both changes.

Schooling (Skul) in Port Vila

In light of Regenvanu's thought-provoking critique (above), I found that Port Vila schools strongly reflect its colonial legacies (Henly, 2005), particularly in the choice of language (English or French) used within schools to deliver and assess the curriculum (Vanuatu Ministry of Education and Training, 2010). Despite Indigenous languages being marginalised in these colonial/neo-colonial school systems, Vanuatu has the highest language density in the

world, with 138 Indigenous languages (François et al., 2015) reflecting the cultural diversity of its Indigenous communities. While the establishment of missionary schools in Vanuatu in the mid-1800s has been discussed in the literature review (Chapter 2), I aim to provide here a brief background to the history of colonisation in Vanuatu.

Vanuatu gained independence from the joint colonial rule of Britain and France in 1980 (Henly, 2005). A gripping poem written by former Prime Minister Donald Kalpokas described this time of colonial rule:

> Pandemonium is the right word
> For my so-called government,
> I long for a day of improvement.
> I travel abroad with an identity card
> For I am stateless and have no right
> Of appeal in my country's high court (Kalpokas, 1974, as cited in Rawlings, 2012, p. 46).

Under the British-French Condominium rule, the Indigenous Ni-Vanuatu were denied citizenship and considered stateless in their own land (Rawlings, 2012). Forsyth (2009) described the oppressive nature of blackbirding and colonisation in Vanuatu:

> The labour trade between Vanuatu and New Caledonia started in 1857 and had extended to Fiji and Queensland by 1863.[11] The trade, known as 'blackbirding', ended only in 1904 and it is estimated that between 40 000 and 61 000 ni-Vanuatu went to work in Queensland during that time … As a result of pressure for annexation from French and British missionaries and settlers, the Condominium was created in 1906.[16] Under the Condominium, the British and the French jointly and equally ruled what was then known as the New Hebrides. The protocol[17] that provided the legal basis for the Condominium authorised the Condominium Administration to make joint laws for certain matters, and also empowered the two governments to establish their own bureaucracies governed by respective French and British laws for other matters, such as police forces, currencies, hospitals and schools.[18] … Calls for independence began in the mid-1960s, sparked by disputes over the system of land ownership under the Condominium, which conflicted with … customary land ownership. (pp. 1 – 2)

French and British colonial administrators eventually took over missionary schools and opened their own schools, before independence As a result, research indicates that by 1980, there were 175 Anglophone and 115 Francophone primary schools throughout Vanuatu (Shipman, 2008). Various Christian denominations continue to run schools in partnership with the Government, and Christian values are prominent in many communities (Vanuatu Ministry of Education and Training, 2020c).

As a Tongan teacher-researcher, who also happens to be a practising Christian who teaches science, I found that my adoption of an autoethnographic methodology was helpful in

the context of conducting research in Port Vila (Chang, 2016, pp. 97 - 99). It challenged me to critically consider the synergy and dissonance between Indigenous, scientific and Christian belief systems. As I explained elsewhere in this thesis, this served to help me see similar tensions in Tonga after engaging in talanoa with participants in Vanuatu, challenging my assumptions about the influence of western education in the Pacific region.

An example of this tension can be seen in the development of the Bislama concept, kastom. Kastom first denoted noncompliance with the religious and economic systems of colonists and missionaries and was used to represent people in a negative light (Walshe & Nunn, 2012). Later, through radio, kastom was promoted as a unifying theme throughout the diverse archipelago, notably by pro-independence politicians who linked kastom to Christianity (Bolton, 1999). Before this, skul was understood as "the antithesis of kastom" (Bolton 1999 p. 341).

Eventually, Father Walter Lini (an ordained Anglican minister of Ni-Vanuatu descent) became the first prime minister after Vanuatu gained independence. In his (1980) Independence Speech, Father Lini spoke of the need for reconciliation between Indigenous custom and colonial constructs of Christianity when he claimed:

> In this and other tests we shall need guidance not only from God but from our own custom and traditional values. We are moving into a period of rapid change rather like a canoe entering a patch of rough water: God and custom must be the sail and the steering-paddle of our canoe (Taylor, 2008, p. 24)

The relationship between kastom and Christianity is also captured in the Preamble to the Constitution which acknowledges ethnic, cultural and linguistic diversity while proclaiming "the establishment of the united and free Republic of Vanuatu, founded on traditional Melanesian values, faith in God, and Christian principles" (Republic of Vanuatu, 2006, p. 6). This view was not, however, shared by all – particularly those who led the rebellion movements based on kastom religion. These movements included the Nagriamel on Santo, and the John Frum Cargo Cult on Tanna (Forsyth, 2009). Research has suggested that church influence, along with formal schooling, contributed to the erosion of local ecological knowledge in Vanuatu (McCarter & Gavin, 2011). These tensions and synergies are considered in the exploration of the understandings of students and teachers of local environmental issues in Port Vila.

Conclusion

My positionality as a Tongan teacher-researcher has shaped the way I encountered others in the research contexts concerned, underpinned by the values described in Chapter 3.

While both Ha‘apai and Port Vila share similarities, such as the prominence of Christianity and British influence, I have also noted, here in this chapter, some of the key historical and socio-cultural differences that informed my study. These included the more obvious factors, such as Port Vila being a highly urbanised setting whereas Ha‘apai is a physically smaller and more remote setting.

Against this backdrop it also raises the question, how do we determine what is “worthwhile learning” (Thaman, 1998b, p. 71) and frame environmental issues in ways inclusive of potentially conflicting cultural lenses including: (i) Indigenous knowledge; (ii) Christianity and (as discussed later in the thesis); (iii) western school science? The following chapters (Chapters 5 - 8), will now draw upon the perspectives of cience teachers and their students to explore how local environmental issues were taught and framed in particular schools in Ha‘apai and Port Vila.

Chapter 5 : Haʻapai Teachers' Talanoa

Introduction

Thaman (1993) asserted that "from the perspective of most of the indigenous peoples of the South Pacific region, it would be an understatement to say that formal education, through the school curriculum, contributed in a very significant way to their cultural transformation – and, many claim, alienation" (p. 250). Considering the tensions between TEK and conventional school science discussed in Chapter 2, it is important to understand how teachers frame and teach students about their local environments. These tensions were explored through talanoa with teachers I met in Haʻapai.

The central research question explored through this chapter is "How are local environmental issues framed by Year 10 teachers of science?" The findings of this study draw upon two talanoa sessions, with two Year 10 science teachers in Haʻapai in 2015. Findings from these two talanoa are complemented by my classroom observations of their teaching and my analyses of the Year 9 and Year 10 Science Syllabus for Secondary Schools in Tonga (Tonga Ministry of Education and Training, 2015). This chapter consequently contains two parts. In Part One, a brief contextual background to complement the information provided in Chapter 4, drawing attention to the social contexts that teachers must teach in. Part Two contains the findings of talanoa with teachers, following the process of talanoa explained in detail in Chapter Three (Methodology).

Part One: Contextual background

As mentioned in Chapter 4, Haʻapai is one Island Group in the Kingdom of Tonga where people live in 30 villages spread out over 17 inhabited islands, although there are 64 islands in Haʻapai in total (Thaman et al., 1997 as cited in Ceccarelli, 2017). In 2016, the population of Tonga was 100,651 and of this, 6,125 people lived in Haʻapai (TSD, 2019). In terms of livelihoods, subsistence agriculture and fishing are ongoing in Haʻapai with fishing being a significant source of protein, income and offerings for cultural obligations (Bender, 2002). Haʻapai is perceived to be "less impacted by westernization" than other islands in Tonga (Veatupu et al., 2019, p.3). Despite its relative remoteness and small population, significant events happened in Haʻapai in the nineteenth century involving Tonga's first Christian King, Siaosi Tupou I – who significantly shaped the future of Haʻapai and the wider Tongan society.

The late King Taufaʻāhau Tupou I, the 19th Tuʻi Kanokupolu, was reputedly born in an outer island of Haʻapai in 1797. He was the son of Tupoutoʻa, the 17th Tuʻi Kanokupolu. While many chiefs resisted the spread of Christianity in Tonga, King Taufaʻāhau Tupou I expressed

his new faith by getting baptised by the British Methodist missionary John Thomas. This baptism took place in his home in Pangai, Haʻapai on the 8th of August, 1831 (Puloka, 2017a). Today, the Free Wesleyan Church of Tonga has its main church building located on this spot, accompanied by the Kolosi Ne Hā Faka-Misiteli (Mysterious Cross), which first appeared on the lawn of this site on 26th of October, 1975 (Puloka, 2017a). It remains a popular attraction in Lifuka today.

Hence, it is reasonable to contend that Christianity has had a major impact upon Haʻapai and this is, amongst other things, reflected in the presence of its local secondary schools, which are all operated by church denominations except for one government secondary school established in Lifuka (Catherwood et al., 2003). This is not surprising given that King Siaosi Tupou I strongly supported the establishment of schools in Tonga by the missionaries and had himself requested that the Wesleyan mission set up Tupou College, Toloa, in Tongatapu in 1866 (Thaman, 1988 as cited in Tapaʻatoutai-Teisina, 2020). Later, Tupou I established the first government secondary school, Tonga College, ʻAtele, located in Tongatapu, in 1882 with the purpose of training men to work for the government (Tapa, 1983 as cited in Latu, 2011, p. 91).

As explained in Chapter 2, in Tonga, various Christian church denominations operate their own education systems, along with other non-government providers, making up the majority of the education providers. In 2001, out of the 40 secondary schools in Tonga, only 9 were run by the Government and 23 of the total schools were located on Tongatapu (Catherwood et al., 2003).

In these schooling systems, most of the science teachers are graduates of the Tonga Institute of Education (diploma level) or the USP or other overseas institutions (Bachelor's level) (Vaka-Vivili, 2014). Teachers are largely allocated positions in schools within those systems throughout the country in a process locally known as *fehikitaki* (staff posting). Consequently, one participant in this study pointed out that Haʻapai is not a favoured place amongst aspiring Tongan teachers because it it is in the cyclone pathway. Hence, it is important to note that the Tongan teacher participants in this study are individuals who were assigned by their employer to teach in Haʻapai.

Talanoa with Haʻapai teachers (Year 10 Science)

The primary method of data collection underpinning this case study involved audio-recorded talanoa (discussions) with participating teachers, which I will refer to as talanoa sessions to distinguish these from informal discussions, which also took place while I was in

Haʻapai. Given that Vaioleti (2006) asserted that talanoa, during research, be underpinned by adherence to Tongan cultural values and norms, this mode of engagement best allowed me to conduct meaningful discussions with the participants, who freely shared their views. With ethical approval from the UC ERHEC and the Tonga Government, I visited Heilala Secondary School located in Lifuka, Haʻapai, for two weeks in September 2015. The participating teachers (Mana and Tōnunga: pseudonyms), were selected by the principal of Heilala Secondary School.

I held two talanoa sessions with Mana and Tōnunga and I carried out five classroom observations in their Year 10 science classes. Elsewhere, I held talanoa sessions with students selected from their classes (see Chapter 6 for more detail). I visited the school again in November 2015 (when I was in Haʻapai for family reasons) to make copies of additional documents from participants, such as student notes and the end-of-year examination. On this trip I was invited to the class where students were given back their graded examination papers, providing insights on the exam-orientated nature of the Education System.

My talanoa sessions with participating teachers, Mana and Tōnunga from Haʻapai, were fluid in nature. This assisted me to understand the range of interconnected factors that influenced how they taught local environmental issues in their Year 10 science classes. Indeed, while not expected, teachers discussed their workload challenges at length and concerns regarding staff allocation from Tongatapu to Haʻapai. As a researcher, I explored how their concerns impacted their ability to engage with local environmental issues and their students. Both teachers (Mana and Tōnunga) shared strategies with me, to explain how they sought to overcome challenges they faced. They expressed a shared desire for change in their own teaching practices. Hence, our talanoa allowed "data collection" to be personal and grounded in relationships shaped by the Tongan culture which united my participants and me, as fellow Tongans living in a rapidly changing world.

This process consequently shifted my focus away from teacher delivery of the curriculum (i.e. teaching environmental science) to viewing teachers' experiences beyond the classroom, in Haʻapai, more holistically. The nature of this case study reflects the assertion of Corbin and Strauss (2008) regarding qualitative research. They propose that the "interesting aspect of qualitative research is that though a researcher begins a study with a general question, questions arise during the course of the research that are more specific and direct further data collection and analysis" (Corbin & Strauss, 2008, p. 27). In talanoa, participants' prior understandings and agendas were reshaped during the process, opening up new perspectives

(Halapua, 2008). As a researcher, I also experienced this as reflected in the evolution of the questions and prompt questions I asked Tōnunga and Mana.

We conversed in both Tongan and English languages during our talanoa, although the two teachers primarily responded in Tongan due to our shared understanding of the Tongan language and culture. Tōnunga's voice was more prominent than Mana's, possibly because of the dual respect for females and for elders in Tonga. The Tongan values of fakaʻapaʻapa (*respect*) and tauhi vā (*maintaining relationships*) meant that I also had to actively listen to answers and attempt to shape follow-up questions based on these, valuing participants as "experts on their own lives … the only authentic chroniclers of their own experience." (Delpit, 1995, as cited in Roberts, 2011, p. 82).

The talanoa discussed in this chapter documents how the two teachers framed local environmental issues in their respective Year 10 science classes and considers other factors which affect schooling in Haʻapai. Where direct quotes are given, repeated words and phrases have been removed and pseudonyms used. The original Tongan language quotes provided in this passage are supported with English translations given in italics. The rationale for this has been discussed in Chapter 3.

Part Two: Findings from the talanoa

The findings of this chapter are divided into three sections, presented under three thematic subheadings; (i) *Learning about the environment is situated*, (ii) *A sense of place in relation to teaching and learning*, (iii) *Teacher learning.* These reflect the recurring themes that arose from the multiple talanoa sessions with Haʻapai teachers in Heilala College. These are supported by classroom observations conducted during my visit to Haʻapai in 2015.

Learning about the environment is situated

In considering how learning TKS (such as making traditional cosmetic oil or traditional fishing practices according to the lunar cycles) takes place in Tonga, Palefau (2005) proposed this happens through situated learning. This argument contends that "learning is a process of participation in communities of practice, participation that is at first legitimately peripheral, but that increases gradually in engagement and complexity" (Lave & Wenger, 1991, p. iii as cited in Palefau, 2005, p. 106).

With this understanding of ako as situated learning, I found examples of this throughout our talanoa as teachers described how they believed their students learn about their local environments in Haʻapai. As mentioned earlier in Chapter 4, there are seventeen inhabited islands in the Haʻapai Island Group (Havea, 2020). Since all the secondary schools, except for

one in Nomuka, are located on the island of Lifuka, frequent travel between the islands by boat is common for some students. Tōnunga explained her students' unique knowledge of the sea, which she asked them to share with her.

> **Tōnunga (Heilala College):** Ko e fānau ko e ōmai mei motu ... rare ia ke haʻu ia nofo taʻu kakato. Pea kuo tuʻo fiha ngeau ene foki ʻaʻana ki hono motú. Ko ia, ʻokú ne mei maʻuloto pē mahalo ia feituʻu ʻoku sio ki aí. ʻOku hifo e tokotaha, puna e tokotaha ko ē, ʻalu hake mo e fuʻu ika ha, puna e tokotaha ko ē ʻalu hake mo e hā ... ne ʻilo ai pē, ko e fuʻu vahaʻá ko ē, ko e lahi ai ʻa e hā … Ko hono pehē ko e motu – pehē ko Lifuka foki ko honau mainland. Ko Lifuká, ʻoku ʻikai ke ʻuhinga ia ko e taʻu kakato heni pea toki foki pē ʻi Tīsema. Ko e hā? ʻOku ʻalu atu, haʻu. Ko e hoko pē ha puke lahi ʻa e tokoua faʻeé, ko e ʻalú ia … Ko e ʻalu ʻo ʻai ʻa e kiʻi meʻakai ʻi honau ʻapí. Ko e birthday celebrate ʻo e kiʻi meʻa, ko e ʻalú ia. Peá ka ʻohovale pē, hangē ko ení "Ko fē ʻa meʻa, meʻa?" "Naʻe ō ia ki motu."
>
> ***Translation:*** *The students that come from the outer islands … its rare for them to stay here for the whole year. They go back to their islands hundreds of times. Therefore, they would likely almost memorise the places they see. One person gets off, one person jumps down and comes up with a certain fish, another jumps off and comes up with something else … then they would know, in this space at sea, you can find an abundance of something … When you speak of the outer islands – remember, Lifuka is their mainland. It doesn't mean they would spend a whole year here and only return to their islands in December. Why? They go to the islands, then come back. When their mother's sister is really ill, they go. They go and cook food for a celebration back in their homes. For a birthday celebration for someone, they go. And then surprisingly, it's like this, "Where is so and so?" "They went to the island."*

Therefore, Tōnunga claimed that her students' knowledge of the sea is due to being in maritime situations where they learn how to catch fish and other seafood as they travel between islands. While this is only one Tongan teacher's perception of her students' knowledge, it does echo the work of Brown et al. (1989), who also noted that "knowledge is situated, being in part a product of the activity, context and culture in which it is developed" (p. 32). This insight may, therefore, hold valuable implications for how environmental learning can be developed in Tongan and Vanuatu schooling systems which is often "predicated on claims that knowledge can be decontextualized" (Lave & Wenger, 1991, p. 40).

Both teachers were from outside of Haʻapai. I was consequently interested in how they navigated learning about the local environment. Both of them confided that they had less lived experience in the local environment and felt this lack of local ecological/place knowledge was impacting upon their teaching. Although they both spoke highly of field trips, they also quickly identified barriers they had encountered when planning such trips. These barriers included financial constraints and the fact that both Mana and Tōnunga had only recently moved to Haʻapai. As Mana elaborated:

> **Mana (Heilala College):** ʻAsinga ko ʻe ma toki fuofua haʻu eni ki Haʻapaí ni, ʻi ai ngaahi feituʻu – hangē ngaahi meʻa ʻoku fekauʻaki mo e lēsoní - ma loto ke ma ʻalu ki ai mautolu, ka ʻoku teʻeki ke ma fuʻu takai atu ʻa Haʻapaí ni ke ma ʻilo ʻa e ngaahi feituʻu pau ...
>
> ***Translation:*** *Since this is our first time in Haʻapai, there are places – such as those related to our lessons – we would like to go to, but we haven't really been all around Haʻapai to know specific sites …*

This statement, above, clearly highlights the gap between the teachers' and students' knowledge of the natural environment and local peoples' epistemologies, ontologies and narratives of place in Haʻapai. Like research conducted in New Zealand (Manning, 2009; Manning et al., 2020), my research, as a result, also highlights the fact that many teachers (whether on a remote island or in a metropolitan city) may feel like commuters or outsiders in the communities they purport to serve. This finding also presents opportunities for the growth of pedagogical strategies which enable students of Haʻapai, Port Vila and elsewhere (and/or their communities) to share contextual knowledge with teachers to co-construct a curriculum.

This is especially pertinent when teachers are less familiar with the areas surrounding their school site which can serve as the students' "living laboratories" (Thaman, 1997 as cited in Thaman, 1998a, p.15). This living laboratories approach, in turn, need to shift teaching towards a dialogical approach both inside/outside the classroom (Freire, 1970/2005). Dialogue in living laboratory (i.e., authentic learning) situations, however, challenges the conventional relationship between teachers and students I have observed in schools in Tonga and Vanuatu. As Freire (1970/2005) described:

> Through dialogue, the teacher-of-the-students and the students-of-the-teacher cease to exist and a new term emerges: teacher-student with students-teachers. The teacher is no longer merely the-one-who-teaches, but one who is himself taught in dialogue with the students, who in turn while being taught also teach. They become jointly responsible for a process in which all grow (p. 80).

A not too dissimilar dialogical practice appears to have been a key part of Tōnunga's cultural orientation into Haʻapai's local ecology. She described the students as trusted sources of ecological knowledge in Haʻapai's community. She also had conversations with the Agriculture Department Staff and market sellers to learn about herbicide and fertiliser usage in Haʻapai. While she showed some scepticism regarding their answers, Tōnunga emphasised the trust she had in what her students know, which is based on their authentic (lived world) experiences. This trust was evident, for example, when she told me what she had asked her students about the marine environment in Haʻapai:

Tōnunga (Heilala College): ‘Oku ‘i ai ha ‘ulu‘ulu he vaha‘a ‘o fē mo fē? ‘Oku ‘i ai ha hā, mo e me‘a?” Pea tala mai, hangē ko ‘eku tala atu ko ē, ‘oku tala mai ko e “angaanga” ko e hā mo e hā, ‘oku lahi ia ‘i fē, ko e hā mo e hā mo e hā, ‘oku lahi ‘ia ‘i fē? Ko e fanga ki‘i story fakaloukolo [local] pē, he ko e ‘uhinga ko e fē ‘omai‘aki ko ē mei motu. ‘Oku ‘ikai ke te fu‘u loko pehē ‘e kita ia ‘oku loi. He ko e ‘uhingá, ‘oku nau sio ki ai he uike kotoa pē he ōmai ko ē ki he akó mo e me‘á. Ko ha me‘á te nau ‘omai ai ha fo‘i loi? … Ko ‘enau reality ‘anautolú ‘oku malava ke ma‘u ai ha info, information lahi.

Translation: *Are there any reefs in-between this place and that place? Are there any so-and-so?” Then they say, like I mentioned before, they tell me “angaanga” and others are abundant in that specific place, while these others are abundant there. These are just little local stories, because they are frequently travelling between here and their island. You would not really think they are lying. The reason being, they see this every week when they come to school. Why would they tell me a lie? … You can get so much information from their reality.*

In the above excerpt, Tōnunga expresses validation of her students’ prior knowledge, which was shared with her in class through the (Indigenous dialogical) process of talanoa. In this light, it is also worthwhile to pay closer attention to Havea’s (2020) research in Ha‘apai. During this study, Havea (2020) conducted an intervention with a science teacher and her Year 10 science class. This lesson focused on addressing the issue of climate change and was underpinned by talanoa – considered to be culturally responsive pedagogy for Tongan schools. She explained that the “students indicated that talanoa helped them to co-construct ideas and helped them learn more from their peers” (Havea, 2020, p. iii).

Havea (2020) also acknowledged the prevalence of teacher-centred (i.e. anti-dialogical) practice in Tonga, but stated her intervention was not intended to challenge this directly, but rather to enhance the delivery of CCE in these (Tongan) settings. It appears, therefore, that talanoa may well be conceived as an initial step in the process of introducing dialogical pedagogies in the Tongan classroom. Other educational research in Tonga has also highlighted the power imbalance between teachers and students in Tongan school settings. Bay et al. (2016) noted that to encourage critical thinking for developing scientific literacy, students needed to feel able to ask questions in their science classes.

Certain research in Tonga has suggested that questioning of teachers is not acceptable given teachers cultural positioning in a hierarchical cultural framework (Bay et al., 2016; Vakapuna, 2019). However, further research needs to be done on the role of silence in maintaining relationships in various learning settings (including those outside of school) in the Pacific as silence is also a way of communicating. As Samoan scholar, Patisepa Tuafuti (2010) posited:

> Silence is an active and a living component of Pasifika culture. One of the basic components of cultural and communicative competence in the Pasifika is to know when, where and how to speak or be silent in various contexts. Silence is a symbolic and fundamental structure of communication. Pasifika peoples, especially elders, comprehend the whole framework that constitutes its (silences) meaning. (p. 4).

Communication, including silence, must then be understood in the unique relationship between teachers and students in their cultural contexts. Thaman (1992a) proposed that Tongan teachers' perceptions of the role they play may be explained by "certain emphases which may be said to characterise the behaviour of Tongan people as a group. These include: respect for rank and authority … importance of the supernatural, 'ofa (compassion) and restraint behaviour" (p. 9). From my perspective, Thaman's analysis of the culture of Tongan teachers deserves attention in relation to the future of science educationi n Tonga and draws attention to the theorising of Paulo Freire (1970/2005), who rightly observed:

> Dialogue cannot exist … in the absence of a profound love for the world and for people … Love is at the same time the foundation of dialogue and dialogue itself … Because love is an act of courage, not of fear, love is commitment to others. No matter where the oppressed are found, the act of love is commitment to their cause—the cause of liberation. And this commitment, because it is loving, is dialogical. As an act, of bravery, love cannot be sentimental; as an act of freedom, it must not serve as a pretext for manipulation. It must generate other acts of freedom; otherwise, it is not love. (pp. 89 - 90)

Given the huge influence of Christianity within Tongan society (Tapa'atoutai-Teisinia, 2020), it is also worth considering the work of Tatafu et al. (1997) in relation to Freire's (1970/2005) proposed pedagogy of love. Tatafu et al. (1997) explained that "for Tongans, genuine love is most often interpreted in its Christian context. It is basically an altruistic love where the concern is for the welfare of others" (p. 67). This emphasis on love, I would suggest, challenges the Tongan teacher of science (or as Freire (1970/2005) posited, the "teacher-student" (p. 80)), to carefully consider how cultural conceptions of love and authority are at work in their pedagogical choices, particularly if their classes are entirely dominated by the teacher's own "narration" of reality (Freire 1970/2005, p. 71). I draw attention here to Freire's (1970/2005) challenge that love must "generate other acts of freedom" (p. 90).

While I agree with Havea (2020) that talanoa, as a dialogical pedagogy, can enhance teaching and learning even in teacher-centred classrooms, I would add that "other acts of freedom" (Freire 1970/2005, p. 90) are urgently needed to support young people to know the value of their own (Indigenous) TEK, and how that may assist them and their communities to respond proactively to our climate and cultural crises. From my perspective, Thaman (2001) has rightly asserted that "regional and national environmental concerns about Pacific

environments must first address the loss of traditional environmental knowledge among Pacific peoples themselves before considering long term solutions to environmental problems" (pp. 12–13).

A sense of place in relation to teaching and learning science

As a result of my talanoa with science teachers in Haʻapai, I came to better understand how place-conscious learning enables meaningful student engagement with local environmental issues. Right from the introductions of our talanoa, Tōnunga expressed her strong belief in practical, authentic learning tasks when it came to addressing environmental issues in any of her classes.

> **Tōngunga (Heilala College):** Ko ene faʻa ai ko ē ʻa e environmental issue ko ē e hoku kalasi, ʻoku ou loto ke practical. Ke hangē ko ení, ko e fuʻu lahi hono taa ʻa e fotuloná pea meʻá, practical ʻe he tokotaha ko ē ke ne tō ia he fuʻu foʻi fotulona ʻe ua noa. ʻOsi ene practical tuʻu e [fotuloná].
>
> ***Translation:*** *When my class covers environmental issues, I want it to be practical. Like this, there are too many fotulona trees [Hermandia nymphaeifolia] being cut down, then one person's practical [assessment] could be to plant 20 fotulona trees. So that the end of his practical the fotulona trees would be planted.*

Tōnunga's description above is reminiscent of authentic learning, which contrasts starkly with conventional approaches to teaching science in schools:

> Science taught in schools often minimizes or leaves out entirely the cultural context of the scientific understanding in favor of the scientific facts as they are currently understood and explained … The idea that students must engage in practices common to their subject area, as well as learning experiences that are meaningful to the social and cultural world outside of school is often referred to as authenticity (Cakmakci et al., 2020, pp. 298 - 299).

However, the difficulty of carrying out authentic learning activities in classroom settings was also noted by Brown et al., (1989) who observed:

> Archetypal school activity is very different from what we have in mind when we talk of authentic activity because it is very different from what practitioners do … Classroom tasks, therefore, can fail to provide the contextual features that allow authentic activity. At the same time students may come to rely in important but little noticed ways, on features of the classroom context in which the task is now embedded that are wholly absent from and alien to authentic activity. (p. 34)

The senior Haʻapai teacher, Tōnunga, identified that learning about the environment would require engaging in authentic research tasks normally undertaken by environmentalists. These could include restorative planting of plants such as tongo (*Rhizophora spp*.), commonly

known as red mangroves (Thaman et al., 2000). Tōnunga added that she believed planting projects were also responsive to the culture of return migration in Haʻapai:

> **Tōngunga (Heilala College):** ʻE tuʻu honau lotó .... Pea manatuʻi foki kau Haʻapai, te nau ʻalu atu. ʻOhovale pē kuo nau foki mai. "Sio ko ē kiʻi foʻi feituʻu naʻa mau meʻa... ko mautolu naʻa mau kamataʻí" … ʻOku i ai niʻihi ʻoku loto ke fai e practical because one day theyʻll come. He? Pea ko e oo ki mulí, fai ko ē … enau kiʻi hā – reunion, fakafāmilí. ʻOku toe ōmai, fakamanatu ko ē ʻa e fuʻu ʻakau ena naʻe hā - (laughter). He? Ka ʻokú te sio atu, ʻoku pehē faka-culture e meʻá. Ke te hū atu kita ai.
>
> ***Translation:*** *It will remain in their hearts … And remember Haʻapai people, they will leave. All of a sudden, when they come back [they'll say], "Look there's the place we did so and so … we were the ones who started it …. There are some who want to do the practical because one day they'll come. Eh? They may go overseas, when they have … their family reunion. They will come back, and remember that tree was – (laughter) Eh? So you can see how it can be related to the culture. And you can connect through that.*

Based on research in Haʻapai, Cave and Koloto (2015) also noted the significance of short-term visits back home to strengthen cultural ties in this "culture of migration" (p. 669). Tōnunga was aware, therefore, about just how culturally important it is for those returning to have tangible connections to the land, through the trees they once planted.

When considering the urgent need to tackle environmental degradation in Haʻapai, particularly the rapid coastal erosion in areas of Lifuka, Tōnunga proposed that environmental learning (complete with tangible/measurable learning outcomes) was critical to a healthy science curriculum in Haʻapai. She consequently advocated for a shift towards an action-orientated approach outside the classroom because she believed this was most effective for both teaching and learning about the local environmental issues of Lifuka. To give an example, Tōnunga suggested that, as part of my research trip to Lifuka, we could plant mangroves with the students, making a real tangible impact on the environmental issues we are concerned about. She explained that:

> **Tōngunga (Heilala College):** Ke tau tooʻi pē ha tongo, just to hangē ha... fakamanatu hoʻo foʻi project… ʻOku totonu ke tau ʻunu tautolu ki he strategy ko iá … Ka ʻoku ʻikai ko e saliva pē, lau pē, lau pē. Pea hili ange ko iá ʻe kei haʻu pē erosion … Mau ō eni he Tokonakí. Ko e feituʻu ko ē naʻe fai ko ē e kai tukumisí. Masiʻi. Hangē pe kou kiʻi loto ke u haʻu ʻo ʻoho noa ki he ongo kiʻi tamaikí. Keli angé ko e ʻa e ʻoneʻoné. Ko e foʻi anga e ko ē, kapau ʻe haʻu pē tahí he taimi pē ko iá ʻo tahi lahi, ko ʻene hū mai pē ko e hū mai ki loto fonua kamata e kiʻi - ʻIkai ke ai fetōtōkaki holó! Foʻi kelí na ange pē … Te loto kita ke te haʻu o ʻoho noa kita, ka fielau ka lea mai ʻikai ko ha Haʻapai kita ia.
>
> ***Translation:*** *We could plant mangroves, just to like … commemorate your [research] project … We should move to that strategy … So it is not only saliva, just talking and*

talking about it. But after all that, erosion is still happening …We went on Saturday. The place where I told you we had gone to eat sea urchins. Man. I wanted to go and say something to two young people there. How they were just digging up the sand. How it was like, if the sea had come up higher at that time, it would come in and come up to the land and start to – They didn't even take sand from different places! But just dug up one spot … I wanted to say something but they might say [I have no right as] I am not a Haʻapai person.

The above excerpt highlights two important aspects of Tōnunga's experience as a teacher in Lifuka, Haʻapai. She was very aware of two anthropogenic threats to biodiversity in Tonga: (i) sand mining, and (ii) the cutting of mangroves (Lovell & Palaki, 2002). Coastal erosion was particularly exacerbated in certain areas of Lifuka by TC Cyril in 2012. In addition to these threats it should be noted also that, previously, subsidence (caused by an earthquake in 2006) had already changed beach morphology and threatened the freshwater lens (SPC, 2014) . Tōnunga's awkwardness in speaking out to members of her and/or her students' community was reminiscent of the concept of edgewalking and from this we see her identity negotiation (Austin, 2010 as cited in Beals et al., 2020). The insider/outsider dynamic is familiar to many researchers.

Teachers' identities are further complicated by the heavy focus on prescribed learning activities. ʻOtunuku et al. (2017), contended that the Examination unit in Tonga has had a big impact on the teaching as assessments are set by the Examination unit based on pre-determined learning outcomes. Tōnunga also advised me she struggled to implement this place-based approach of planting mangroves, for example, in her classes because curriculum projects were moderated by a representative from the Ministry of Education who did not support the idea.

Tōnunga expressed her desire for what an authentic localised (place conscious) curriculum could look like, emphasizing that when teaching about environmental issues at any level, "field work is a must". She suggested the school should have a subject budget to help finance fieldtrips. Tōnunga believed science teachers in Haʻapai and elsewhere must have necessary fieldwork skills, such as guiding students in observing, making inferences and decision-making, based on the data students collect during an investigation into a local environmental issue, such as coastal erosion in Lifuka. She also highlighted how this could lead to community awareness and action led by the students based on their inquiry:

Tōngunga (Heilala College): Peá te nau lava ʻo fai ha faʻahinga tala ki tuʻa, he? Te nau ō ʻo tala atu, ʻoku ʻi ai ʻa e ngaahi kolo ʻoku fuʻu faingatāmaki … Do something about it, kamata mei fē, he? … ʻE ʻilo ai ko fē kolo ʻoku faingatāmakí. Kamata mei ai … Ngaahi skills ki he field work ʻoku fuʻu fie maʻu ʻaupito … ʻIkai ke totonu ke kei nofo pē tautolu ʻo theory. ʻOsiʻosi e kuonga ko iá. I think. Ko e taimí ni, its action,

> action. He ko e ʻuhingá, ko ena, ko e fuʻu palōpalema pē, right in front of us; global warming, climate change … Why still sit and learn about the theory?
>
> ***Translation:*** *Then they would be able to report in some way to others, eh? They will go out and report, there are some villages [in Lifuka] which are highly at risk … Do something about it, where do we start from? … They will know [from their inquiry project] which village is most at risk. Start from there … Skills used in the field work are really needed … We shouldn't just continue with only learning theory. That era is over. I think. Now, its action, action. The reason being, there, the problem is right in front of us; global warming, climate change … Why still sit and learn about the theory?*

The above excerpt describes a vision aligned with place-conscious education, as advocated for by Gruenewald (2003a):

> Place-conscious education, therefore, aims to work against the isolation of schooling's discourses and practices from the living world outside the increasingly placeless institution of schooling. Furthermore, it aims to enlist teachers and students in the firsthand experience of local life and in the political process of understanding and shaping what happens. (p. 620)

However, there is a further push among Indigenous educators to go beyond western conceptions of place-based education, and as Hawaiian scholar Manulani Meyer stated, "learn from the land and not simply about the land" (Meyer, 2004 as cited in Fitzgerald, 2018, p.15). This highlights the need for place-conscious education to be done through the lens of the Indigenous culturally shaped relationships to place. An example of how this could be carried out in Lifuka requires a consideration of a cultural understanding of fonua. Tuʻitahi (2005) described fonua as:

> "Land and its people and their on-going relationships, a concept that is present in many other Pacific cultures … It refers to the intricate web of connected, on-going relationship between the entire physical and social environment and humanity, and between man (and women) and his fellow human beings (Mahina, 1992, 2005; Taufeʻulungaki, 2004) … Central to the explanation of fonua by Taufeʻulungaki [2004] is the interdependent relationship among peoples, and between people and the environment. The ultimate purpose of this relationship and exchange between the environment and humanity is to maintain harmony in life in sustainable ways. (p. 19)

In Haʻapai the products of subsistence fishing and agriculture are shared through systems of fetokoniʻaki (sharing between family members or neighbours) and fatongia (obligations i.e. to church, village and kin) based on the "central value of ʻofa, emphasizing love, concern and generosity" (Bender, 2002, p. 59). The TKS enable the reciprocity which drives the Tongan traditional economy. A matāpule (talking chief) interviewed by Palefau (2005) described features of the traditional economy:

> Economy, in our culture, means partnership, love and sharing responsibilities …when there is funeral you come with a pig, and I bring one, the family brings one and that will satisfy everyone … the old days were like that. When a house is built, we all come together, of our own free will, to help … if someone goes fishing … we all share his catch. That is how I define economy (Nukutavake [pseudonym], 5 Feb 2003) (p. 197).

Bowers (2002), meanwhile, is critical of education which ignores the cultural roots of the ecological crises and instead he calls for recognition that "the consumer/technology dependent lifestyle in the West, which is now being promoted in 'undeveloped' regions of the world, increases the impact of contaminated environments on those groups least able to protect themselves" (p. 30). As a result, Bowers (2002) has advocated for an eco-justice pedagogy which sustains the traditional interdependent practices of communities such as those in Ha'apai. This was particularly evident, for example, when he claimed that:

> The relentless drive to commoditize more aspects of daily life, and thus to create new markets and thus new forms of dependencies, is a key factor in the cycle of production, product obsolescence and misuse, and environmental contamination that is contributing to the rapid changes we are witnessing in natural systems … There is also a need to use the educational process to regenerate the non-commoditized skills, knowledge, and relationships that enables individuals, families, and communities to be more self-reliant – and thus to have a smaller ecological impact … Learning about (and thus valorizing) the non-commoditized traditions of ethnic minorities should also be part of an eco-justice curriculum. Many of these cultural groups have survived economically and politically repressive environments because of their ability to carry forward the intergenerational knowledge that enabled them to be less dependent upon the consumerism that more privileged groups took for granted. (pp. 30 - 31)

This is an important consideration for science teachers, like Tōnunga, who expressed a desire to raise critical awareness in students about actions taking place in their community via authentic/practical/place-conscious learning projects, as described previously.

Upon reflection, I believe many of the tools for an eco-justice science curricula already exist within our Tongan communities and the traditional wisdom passed down from the elders known as tala-ē-fonua. Tala-ē-fonua is "an indigenous account of the land and its people" (Mahina, 1992). It is an earthy, practical concept. According to Rev. Dr Mohenoa Puloka, it is "[the] main traditional stories of the origin, development and growth of Tonga. In short, tala-ē-fonua is the foundation and founding story of Tonga. Songs, poetry and legends are the main sources of tala-ē-fonua" (T.T.M. Puloka, personal communication, November 26, 2020). Manu Faupula composed a dramatic representation of the traditional Tongan lunar calendar, Lau Māhina Faka-Tonga, often performed by Queen Sālote College in Tongatapu where she worked for many years. In this drama, the traditional lunar months are depicted as children of

the legendary figures, Hina and Sinilau. In the drama Hina and Sinilau give instruction on seasonally appropriate work which must be completed in each month:

> Polopolo e fua e ngoué, ʻInasi e tuofafiné
> Uki ʻa falehanga, Tofuhiaʻanga ia e kau tangatá
> ʻAua, ko e feveitokaiʻaki e nofó,
> Ko e taufatungamotuʻa ia ʻo e melinó (Faupula, n.d., p. 10).
>
> ***Translation:*** *First fruits of the farmer's harvest belong to his sisters*
> *Women's work is to be ongoing, providing enough for the men*
> *The reciprocal care in communal life,*
> *Is the ancient foundation of peace.*

The gendered division of labour and reciprocity among kāinga captured by this poetry, exemplify traditional wisdom to "maintain harmony in life in sustainable ways" (Tuʻitahi, 2005, p. 19). The poetry in the drama also contains extensive wisdom of bio-indicators of seasons, making it a reservoir of TEK along with community members who continue to gain resources through traditional means of fishing and famining. If an eco-justice pedagogy is ever to be implemented in science educationin Tongan schools, it only seems logical that science teachers will need to engage with those pedagogies already present in the communities they teach within.

Place-conscious science pedagogies contrast starkly with conventional classroom teaching approaches, which are hugely informed by written (summative) assessments. This became more evident to me from a lesson on asexual reproduction in plants described by Tōnunga. Prior to this lesson, Tōnunga had requested that students bring asexually reproducing plants, such as lilies, to class so they could "really see" a new plant being formed from the parent over time. She believed practical activities allowed students to better demonstrate their understanding in an authentic way by providing a valid alternative to the usual English written assessments. She reasoned that:

> **Tōngunga (Heilala College):** Ha meʻa ʻoku tala atu he konitení, kapau ʻoku carry out fakatatau mo ia, ʻosi. ʻOsi totonu ke award maaka kakato .... Kaeʻoua tali ke toki ōmai ʻo write... ko e ʻIngilisí ʻoku ʻikai ke fetaulaki.
>
> ***Translation:*** *Whatever is written in the content, if they carry it out accordingly, done. You should award the full mark … But do not only wait to for them to write … their English is not proficient enough.*

Tōnunga subsequently presented experiential learning as both a way to learn and to demonstrate understanding for assessment purposes. This contrasts with the current model of assessment in Tongan secondary schools for science, which requires English language

proficiency since examination papers are all written in English (‘Otunuku et al., 2017). This clearly disadvantages those Tongan students who struggle to speak or write in that colonial language. However, *Guiding Principal Four* of the *Science Syllabus* (Tonga Ministry of Education and Training, 2015) clearly requires a “bilingual approach to Curriculum Delivery” (p. 3). Tōnunga explains that supports the use of Tongan language in her classroom because her students are not competent in English, thus she swaps between the two languages to enable them to translate and comprehend concepts emanating from the English language.

In observing Mana’s Year 10 science class, I noted that he took the role of being a translator of the notes given to students to ensure coverage of the syllabus:

> *[Mana] said he’s explaining the notes from yesterday. These are still on the board behind him. Mana reads the notes in English line by line and translates them into Tongan … [Mana] mentions that Tonga doesn’t have certain chemicals which are mentioned in the notes. When giving examples of oxidation reactions he referred to an everyday example of the door handle rusting… Continuing on with explaining oxidation and how it is prevented he used an example of kupenga (fishing net) weights and how they are coated so they won’t rust till after a long time … I note that throughout the presentation of the content he uses rust (‘ume‘umea) as a context for oxidation … Mana asked if there’s any questions. He asked three times and then wrote some exercise on the blackboard.* (Classroom Observation Notes, 10th of September, 2015)

Later in class, Mana (a less experienced teacher) brought in rusty metals and showed his students how sandpaper can be used to remove rust, demonstrating what is stated in the notes. Although Mana used multiple (culturally familiar) examples to try to contextualise the notes, he still focuses on learning within the walls of the classroom (rather than out of the classroom). When considering how to use contextualised activities in the teaching of science with emergent bilinguals, Tolbert et al. (2019) alternately recommended the following approach be adopted:

> In contextualizing science activity, when planning for meaningfulness and relevance in science, teachers think carefully about how to frame the unit or lesson using an overarching driving question or real-world problem. The goal is to facilitate scientific sense-making and language and literacy development in the context of science-related social issues or locally relevant phenomena. (p. 1072)

Upon reflection, it was obvious to this observer that students in Mana’s class did rely heavily upon him to translate words for them from their source of knowledge (i.e., the English notes). They clearly needed help to understand new scientific concepts in the language they could comprehend (i.e., Tongan):

> *One girl asked Mana what the English word is for something … [Mana] then explained all the questions in Tongan while the students worked through them … He reads out the English answer from the textbook and the kids copy it.* (Classroom Observation Notes, September 10, 2015)

In my next classroom observation in Mana's class, I note that he often wrote up notes for the class to copy on the blackboard and I recorded*: "Notes are on [about] metals and acid. He copies notes from the same textbook as last time [New Zealand text]"* (Classroom Observation Notes, September 14, 2015).

While Mana has extensively used the Tongan language to explain concepts in class, the centrality of the notes from the foreign textbook cannot be denied. In this case, it was clearly apparent that English was the superior language, the language of (official) knowledge since it was also the language of the textbook and the eventual summative assessment task. This left me pondering to what extent this state of affairs may in turn devalue not only the Tongan language but the TEK of communities like those in Haʻapai? Elsewhere in the Pacific, Otsuka (2007) noted the effects this sort of scenario can have upon Indigenous peoples' desire to maintain their Indigenous language and thus TEK, using an example from Hawai;i:

> What pushed the shift to English was the speakers' recognition that English was key to socioeconomic success. The unfortunate outcome of language shift was brought about largely due to the willingness of the people to give up Hawaiian for English for socioeconomic reasons (voluntary language shift), which in turn was the result of the enforcement of the School Law 1896 (forced language shift). (p. 449)

Closer to home, Taufeʻulungaki (1994) conducted quantitative research in Tonga and found that "there are significant differences in the attitudes of the different age groups with the older age groups favouring Tongan while the younger age group favours English" (p. 99). Otsuka (2007) furthermore, noted that in Tonga, certain government schools, such as the school I currently work at, Tonga High School, punish students for speaking Tongan since they are meant to speak English only. It appears that the "hidden curriculum" which determines, "what it means to be a student: how to please the teachers, how to pass exams, how to belong to groups" (Engeström, 2009, p. 58), frequently promotes English as the language of science learning and success. The implications of this finding are discussed further in Chapter 9.

Teacher learning

In our talanoa, the two science teachers in Haʻapai openly discussed constraints in their practice, which they felt seemed to impact the quality of their teaching. Despite the time constraints and other pressures caused by the imposition of a mechanical (assessments driven) timetable, Mana and Tōnunga had developed strategies to work together collaboratively. For

example, they split topics as an approach. Mana best explained the reason for this "team teach" approach as follows:

> **Mana (Heilala College):** ʻIkai pe ke u fuʻu lava ʻo mateuteu au. He? Ka naʻe ʻalu ʻo aʻu ki ha taimi naʻá ma team teach. ʻUhingá, "[Tōnunga], kātaki ʻo lele koe konga Paiō. Mahino ʻokú ke fuʻu mature ʻaupito koe ia ai ... toʻo mai ʻa e konga Fisikí kiate au" … Naʻe ʻalu pē ʻo aʻu ki ha taimi, ma lele peheē ʻUhingá pē he ʻoku lahi ʻa e moʻumoʻua.
>
> ***Translation:*** *I am not really able to prepare. Eh? And it came to a time, we started to team teach. What I mean, "[Tōnunga], please run through the Biology unit. Since you are more mature in that area … I'll take the Physics unit … It got to a time where we did that. Just because we were busy with many things.*

The Tongan proverb "Takanga ʻenau fohe" translated as "their oars are mates" (FWC Education Office, 2007, p. 24) encapsulates this collaborative approach. This proverb refers to people, such as teachers, who work in agreement to reach a particular goal, like oars working together to move the canoe forward. From her perspective, Tōnunga wanted to extend this collaborative approach across schools so that teachers in the same subject area could support each other by pooling resources and potentially teaching in each other's classes. She proposed to do this through reviving the subject associations, such as the science teachers' association.

Interestingly, Vaka-Vivili (2014) offered a similar recommendation based on the findings of her research, which explored professional development for science teachers in Tonga:

> One sentiment expressed by all is "the need to revive the science teacher association", which seemed to have gone into dormant mode for a number of years now. All four CEO's [of Education Systems in Tonga] recognised that the subject association provided a great support base for teachers and new graduates out in the schools. They expressed that the science teacher association needs to be revived. (p. 72)

The potential of subject associations was highlighted by the 2018 conference for the *Tonga History Teachers Association* (THTA), which recognised the need for training to support culturally responsive practices among teachers. The THTA further aimed to identify ways the association could support "teachers' pedagogical practices in the classroom through in-service training and development" (Faʻoliu-Havea et al., 2018, p. 7). Professional development opportunities for teachers is, consequently, an area which requires further research (well beyond the scope of this study) to fully investigate how science teachers' associations in rural areas of Tonga could support teacher professional development.

Collaboration may not be the only solution required to address teachers' workloads as my talanoa with Tōnunga and Mana seemed to point to systemic issues regarding the ethical

nature of schooling, particularly when it requires teachers to work longer hours for no extra pay. On top of their class time with students, I observed both teachers preparing and providing notes for the students according to the syllabus. They also worked long hours preparing practical laboratory activities, setting and marking assessments and attending departmental meetings. In their school, Tōnunga and Mana both taught across different departments (not only science, and across different levels (junior and senior). As a teacher, I recognise this requires more planning time as each class has such different content and Tōnunga expressed this sentiment as well.

As a result, Tōnunga used the following metaphor to describe the burden she felt regarding her experience of not having enough time to plan due to her workload yet still turning up to class:

> **Tōngunga (Heilala College):** Te haʻu, sio mai ki he fānaú ʻoku talitali angé. Hangē, ʻokú te ʻosi haʻu kita mo e loto mafasia, pē ʻoku siʻi malimalí ke ʻange hā? Hangē ha hā? Ha manupuna ʻoku haʻu ko e pē naʻe kei sai ʻene hunt. Siʻi tali ange ʻa e fānaú ... ʻA ia ʻokú te loto lavea ai pē kita he taimi ʻe niʻihi.
>
> ***Translation:*** *When you come and see the children waiting for you. It's like you come with a heavy heart, what will you give the smiling faces? What is it like? A bird returning after a poor hunt. The children are waiting [expectantly] ... So at times your heart is wounded [by this].*

Tōnunga also mentioned the impact her heavy workload was having upon her family life, leaving her with less quality time with her children, given she would often arrive home exhausted from work. Heavy workloads are not unique to the teachers of Haʻapai. In his research on science education in PNG, for example, Najike (2004) also found a participating teacher to be fully loaded with teaching, planning and marking activities. This teacher also reported not having enough time to teach prescribed content. This came at a cost to the students themselves because, as Najike (2004) explained, the teachers, "were usually pressed for time and so practical sessions became relatively fewer in number and most teaching comprised reviewing main points covered in the last lesson, introducing a new topic, writing of notes on the board, explaining by the teacher, marking of problems" (p. 126). The concern of workloads and balancing this with family responsibilities also came up in Port Vila and is a concern I can also relate to teaching in Tongatapu.

Research in Vanuatu similarly suggests that the emphasis on examinations in the curricula maintains the "constant use of chalk and board and rote learning" (Lumelume, 2007, p. 190). How does this emphasis create a feeling of time pressure among students? In research among New Zealand teachers, Manning (2008) found that his "teacher participants felt pulled

between the demands imposed by their rigid school timetables and the loss of their personal time" (p. 214). Due to this, they would be unwilling to work extra hours to collaborate with local iwi (tribes) in the co-design and delivery of place-based learning activities.

In light of this literature from around the Pacific, I began to wonder what Mana and Tōnunga felt the examination-driven nature of schooling was having upon Ha'apai students' learning. Hence, during my classroom observations in Ha'apai, I attended two of Tōnunga's Year 10 science classes and wrote the following notes:

> *Tōnunga gave her students a choice of when their assessment should be due. She told the class that the point of having assessment due dates in form 4 [Year 10] is for them to get used to assessments in form 5 and form 6 in which, she explained, you only get 1 or 2 days to complete them … [Tōnunga] explains one-on-one to student while other students write up their answers to an exercise on the board. [Tōnunga] corrects work in front of the class on the board.* (Classroom Observation Notes, September 9, 2015)

In the next class I observed (September 11, 2015), I noted that Tōnunga had now copied notes on the board, which the students copied as well. She reminded her students that the chemical equations she was giving them were Year 11 level and she reminded students how the equations should be written in exams.

It subsequently appeared that in Year 10 in Ha'apai there was a strong focus on teaching science to prepare for the next level of schooling. This is because Year 11 would be the level students sit their first national examination, moderated by the Examination unit, the Tonga School Certificate. While I was not able to observe a science class that was doing hands-on practical activities, the teachers were nonetheless working with students towards covering the learning outcomes listed in the Year 10 science syllabus (Tonga Ministry of Education and Training, 2015) for the *Material World* unit. These include, "list the metal reactivity series with the most reactive at the top" (p. 38) and "write and balance the equations for the reactions of metals with oxygen, water and acids" (p. 38).

The view of Year 10 as the foundation year for senior levels of schooling was strongly expressed in our talanoa by both Tōnunga and by Mana, who said:

> **Mana (Heilala College):** 'Ikai ke 'i ai ha topiki te pehē 'oku kovi, 'oku mahu'inga tatau kātoa pē … meimei ko e fakava'é, fakava'e kātoa pē mei lalo ki 'olunga fakalēvolo ... nau toki 'alu hake 'o mapakipaki, na'a nau 'osi kau kātoa pē 'i lalo he foomu 4.
>
> ***Translation:*** *There is no topic that is bad, they are all of equal importance … it's almost like a foundation, foundation for all of the subjects from the lower to the higher levels … The subjects will branch off at higher levels, but they were all already included in [Year 10].*

It appeared that while Year 10 students in Haʻapai do not have external exams, much emphasis is still placed on preparing them for further levels of schooling, ultimately towards a career. This creates a pressured environment which, in turn, maintains teacher-centred pedagogies as teachers believe these methods will best prepare the students to pass exams and proceed to the next level of schooling.

While I sincerely believe the teachers were well intended in trying to equip students to pass exams, I also recall this timely warning from Brown et al. (1989):

> Students may pass exams (a distinctive part of school cultures) but still not be able to use a domain's conceptual tools in authentic practice … They need to be exposed to the use of a domain's conceptual tools in authentic activity – to teachers acting as practitioners and using these tools in wrestling with problems of the world. Such activity can tease out the way a mathematician or historian looks at the world and solves emergent problems. The process may appear informal, but its nonetheless full-blooded, authentic activity that can be deeply informative – in a way that textbook examples and declarative explanations are not. (p. 34)

In reflecting on my own teaching practice, I have wrestled with tension between the often-conflicting demands of being expected to prepare students to successfully pass exams and my own desire to plan and deliver meaningful, practical, authentic learning tasks. I must also admit, however, that I have often opted for exam-oriented learning and while I may have carried out practical learning activities, these have been much less frequent than the ideal. This has largely been due to the time taken to plan and set up these activities, never mind the constraints imposed by the 50 to 60 minute duration of a lesson. As a result, I can well relate to the metaphor used in Manning (2009) to describe the plight of New Zealand's history teachers as being like those of tuna (eels), caught in a hīnaki (eel trap):

> Tuna [eels] trapped in a hīnaki tukutuku [baited eel trap], provide a metaphor to describe how the teacher participants viewed their plight as professionals, all of them describing themselves, for example, as feeling trapped by the ideological constraints of the institutional cultures of their schools … However, the metaphor needs adjusting insofar as the teacher participants can always choose to exercise agency and at least try to resist the reproductive process of an hīnaki like school culture (or remove themselves from it). (pp. 247 - 248)

Perhaps, in the context of my study, acts of teacher resistance include those discussed in the first two sections of this chapter, which focused upon place-conscious and culturally grounded learning.

While Mana and Tōnunga faced multiple challenges in their teaching, they still shared how much they enjoyed teaching and learning alongside students through practical activities – outdoors. Tōnunga clearly enjoyed the practical activities she carried out with the students such

as plant asexual reproduction and a tropism experiment they did, seeing how plants grow toward sunlight when placed in dark places. The latter experiment was even extended into an inquiry where they tested for starch to measure how much would be produced in these conditions. Tōnunga described her joy of teaching, particularly the topics related to biology and chemistry, which she felt held the greatest relevance to the lives of her students:

> **Tōngunga (Heilala College):** Ko e ʻuhinga ko ʻete sio ki heʻenau "Wow" mo e meʻá, ʻoku toe fakafiefia ka kita henau seeing it for the first time. Pea mahino ʻoku ʻi ai ʻa e learning ʻoku take place, eh? Ka ko ʻete fiefiá ko ē, ki heʻete sio ko ē, ki he ʻaa honau matá. ʻOku fuʻu rewarding ia. ʻOku ifo ai ʻa e teaching … ʻOkú te enjoy ʻe kita ʻenau lava ʻo work out "…Oh, ko e neavé ʻoku pehē?" … mahalo ʻoku nau haʻu ʻo fakafekauʻaki ʻa e meʻa ʻoku nau learn mo ʻenau reality … ʻOku ou pehē pē ko e faʻahinga topiki ʻoku fakatupunga ke nau enjoy ʻa e school.
>
> ***Translation:*** *When you see them saying "Wow" and stuff, it makes me happy when they are seeing it for the first time. Then you know learning is taking place, eh? And you feel happy to see their eyes widen. It's very rewarding. It makes teaching fulfilling … You enjoy seeing them being able to work out "Oh, the nerves are like that." … Maybe they come and relate what they are learning with their reality … I think these are the topics which make them enjoy school.*

Mana also enjoyed being a science teacher in Haʻapai, although he also taught classes in the Tongan language and maths departments. Being a junior science teacher allowed him to learn alongside students, particular through practical experiments in the *Material World unit*. I had asked teachers what their favourite part of the science syllabus was to teach. According to Mana:

> **Mana (Heilala College):** Ko e foʻi konga ko eni ko ē he Kemí. Neongo pē ʻoku ʻi ai ʻa e Fisikí, kou ʻosi experience ai … ko e meʻa ʻoku ou saiʻia ʻi he fanga kiʻi konga ko ení ... ke mau ako fakataha mo e kau leká. ʻOsi mahino pē noutí ia, ka ko e ngaahi konga faka practikoló, te mau ako fakataha ai pē mo e kau leká.
>
> ***Translation:*** *The unit on Chemistry [Material World]. Even though there is the Physics [unit], I'm already experienced in that … the reason I like these sections … because I learn together with the kids. The notes are already understandable, but for the practical parts, I learn together with the students.*

These two teachers' enjoyment of the practical components of the syllabus should be taken seriously given that teacher retention is clearly a problem in Tonga (Vaka-Vivili, 2014). When comparing what Mana and Tōnunga enjoyed in relation to my own relatively short experiences as a science teacher, I cannot help but agree with the assertion that "schools should be places that support learning by teachers, as well as students" (Cooper & Alvarado, 2006, p. 19).

As a first-year teacher assigned to Haʻapai, Mana told me that he had benefitted from the mentoring of Tōnunga, who was much more experienced. He was grateful that she had supported him through the "team teach" approach and by providing resources (such as notes) for his classes. While this seemed to be an informal arrangement, this further highlights the benefits and need for mentoring among teachers to promote on-going learning. This approach to mentoring could be developed by drawing upon the metaphor implicit within Langa Fale Ako Framework (Johansson-Fua, 2008). This framework revolves around the metaphor of a traditional fale Tonga (*Tongan house*) to illustrate "a developmental approach to teacher education" (p. 2), using culturally relevant imagery. Of particular interest are the overlapping layers of holisi pola (*walls woven from coconut leaves*) in the Langa Fale Ako Framework (Johansson-Fua, 2008). The first of these layers is termed, "Pola ko ʻPotopoto ʻa Niumui'", which are described in relation to the other layers as:

> Young apprentices [i.e. teachers] who are just beginning their learning. The first pola on the wall represents the teacher trainee and the first year teacher. They are still developing their knowledge, their pedagogical approaches and their profession as such they need the guidance, the mentoring of the Potoʻi Faiako … the term given to the teacher who has been in the system for a sufficient time to gain skills [and] knowledge that can be taught to others … The Potoʻi Faiako is also a teacher who can provide leadership and mentor the Potopoto ʻa Niumui as well as those who are still in progress towards the Potoʻi faiako. (pp. 4 - 5).

In consideration of Manaʻs reliance on Tōnunga for guidance, the above framework relates Mana's teaching experience to Potopoto ʻa Niumui. Here, however, I also wish to draw attention to the work of Lave (2009) who described how learning takes place in everyday life, to reflect on my own experience as a teacher-researcher of ongoing learning with the Langa Fale Ako framework (Johansson-Fua, 2008). As a result of reflecting upon Mana's concerns, I came to realise the significance of situated activity in my own professional development as a young teacher of science:

> Situated activity always involves changes in knowledge and action, and "changes in knowledge and action" are central to what we mean by "learning." It is not the case that the world consists of newcomers who drop unaccompanied into unpeopled problem spaces. People in activity are skilful at, and are more often than not engaged in, helping each other to participate in changing ways in a changing world. (Lave, 2009, p.201)

If teachers can learn from each other, I was left pondering can this framework not be extended to include community members? One of the pou (posts) in the Langa Fale Ako Framework, the Pou ko ʻIlo (Knowing), for example, is described as follows:

> Teachers need to be equipped with the right and appropriate knowledge for teaching. Teachers are also encouraged to be creators/builders of knowledge as well as transmitters of knowledge. This knowledge is grounded on the foundation of the fale – the kelekele – which symbolises the core values of Tonga. Reflective of a changing society, the Tonga teacher is also expected to have sufficiently mastered Pacific and global knowledge systems as they pertain to their teaching subjects (Johansson-Fua, 2008, p. 3).

As Palefau (2005) proposed, TKS can be passed down through apprenticeship (aligning with Lave and Wegner's (1991) concept of situated learning) and via the participation of elders – sharing their knowledge (TEK) with students. It seems only logical that the same process could also be adopted by science teachers seeking to abide by this following guiding principle of Tonga's science syllabus, which states: "Recognition of the uniqueness of Tonga, its people and its culture …. [offering] students the opportunities to develop themselves and their understanding of their own culture through Science" (Tonga Ministry of Education and Training, 2015, p. 3). The potential for adopting this approach, by drawing upon international literature regarding other Indigenous communities' experience, is therefore discussed further in Chapter 9.

Conclusion

As a result of my talanoa with two teachers in Haʻapai (Mana and Tōnunga), I was able to sit with them to theorise and unpack their practices and aspirations as faiako (*teachers*) in Haʻapai. Here in this chapter, I have specifically shared our talanoa as a response to a recurring challenge facing Pacific educators – that is to "reclaim our education, to look at the sources of our identities, and develop philosophies and strategies for teaching and learning that are rooted in our cultural values and practices" (Thaman, 1998a, p. 76). I believe the teachers central to the talanoa reported in this chapter have highlighted pedagogical strategies for ako to occur in ways which are grounded in a concern for the environment, and culture of the people of Haʻapai.

Firstly, both teachers recognised that their students' knowledge of the environment resulted from lived experiences in Haʻapai, particularly their interactions with the marine environment. This was in contrast to the limited prior knowledge of Haʻapai's environment both teachers possessed after recently migrating to Haʻapai for their teaching positions. One teacher, Tōnunga, exhibited aspects of dialogical pedagogy (Freire 1970/2005) when she explained why she highly trusted her students' TEK narratives – which were clearly rooted in their lived experience and formed reliable sources of local knowledge. A need for further research was identified regarding how dialogical practices (including silence) shape

relationships in learning settings between teachers and students in Pacific contexts. Any serious attempt to enhance the delivery of science curriculum in Tongan schools must consider the prevalence of teacher-centered practice and what alternatives to this exist within Tongan cultural learning settings.

Secondly, this chapter has considered the potential application of place-conscious education (Gruenewald, 2003a) and eco-justice pedagogies (Bowers, 2002) with regard to the two teacher participants' aspirations for their future teaching of science in Ha'apai. Particular attention was drawn by both participants to the local context of coastal erosion in Lifuka and how their students may learn while responding practically and proactively to this issue (i.e., through activities such as replanting of coastal vegetation). However, these pedagogical approaches contrasted with the teacher-centred practices often found in Tongan secondary schools, which rely heavily on notes and assessments in the English language. This, in turn, typically creates student dependency on the teacher for both language and content knowledge.

Thirdly, this chapter has explored the shared view of both participants that Year 10 science essentially serves as a foundation level for Year 11 science. This in turn serves to maintain teacher-centred (i.e. anti-dialogical) practices. Both participating Year 10 teachers experienced the same time and assessment pressures as other teachers around the world – who often struggle with the rigidity of the school timetable and assessment requirements (Manning, 2009). Amid these challenges, however, I found two science teachers who reported their enjoyment of collaborating with each other and learning alongside their students through practical activities. The most experienced teacher, Tōnunga, provided guidance for Mana, who was in his first year of teaching. Hence, this chapter has drawn attention to some possibilities for the future of in-service teacher education in Tonga that could be designed to involve community input in ways that are informed by the Langa Fale Ako Framework (Johansson-Fua, 2008).

To conclude, this chapter has dealt with two key aspects of being a faiako (teacher), which Thaman (1998b) highlighted: "doing the learning or making the learning happen" (p. 73). A central theme that emerged from this chapter, moreover, emphasised both teachers' desire to: (i) move beyond the classroom for meaningful science educationwhich has practical implications for the community and, (ii) for the science curriculum to directly address the most immediate and pressing environmental issues they face, where they live – Ha'apai (Tonga). The following chapter will now consider how students conceptualise their local environments and how they are actively learning about these, inside and outside of school in culturally meaningful ways.

Chapter 6 : Haʻapai Students Talanoa

Introduction

In a book published as part of the Pacific regional initiatives for the delivery of basic education project, Dr Priscilla Puamau (2005) introduced her chapter on the principles and process of educational planning in the Pacific with this statement:

> Indirectly, this chapter is in many ways a 'writing back' to the colonial histories of Pacific people as they chart their way through their past and present to get the best outcomes for the future development of education in the region. Within the confines of globalisation and the culture of donor assistance, they can 'rewrite' their own educational histories and reconstruct their own educational identities and systems (p. 25).

This chapter (6), similarly, involves a 'writing back' process that is designed to assist Year 10 science students of Haʻapai to share their views on science education. Furthermore, it explores the stories students shared with me of their communities and the challenges they faced regarding environmental issues. As Pacific teachers "chart their way" (Puamau, 2005, p. 25) to new educational directions, we must carefully consider students' concerns, aspirations and ways of seeing their worlds. The central research question underpinning this chapter therefore asks: "How are local environmental issues conceptualised by Year 10 students of science in Haʻapai?"

The findings of this case study draw upon two semi-structured talanoa with two groups of Year 10 science students in Heilala College (pseudonym), Haʻapai. One group of students was selected by Tōnunga from her Year 10 science class and the other group of students was selected by Mana from his science class as discussed in Chapter 3 (Methodology). Similar to Chapter 5, the findings from the talanoa sessions – central to this chapter – are supported by my classroom observations and my analyses of the science syllabus (Tonga Ministry of Education and Training, 2015), and participating students' science notebooks. This chapter is presented in two parts. Part One outlines the contextual background of Haʻapai, paying particular attention to how local communities in Haʻapai are organised, and considering how this may influence students' cultural socialisation and understanding of the local environments.

Part One: Contextual background

In the Kingdom of Tonga, the island group of Haʻapai is often "idealized and mythologized as a cultural centre, the place where old-style traditional Tonga persists" (Young-Leslie & Evans, 2001, p. 6). In Haʻapai, subsistence fishing and agriculture can provide food and income for families as well as offerings for obligations in the church and village networks

(Bender, 2002). It is important to recognise the role churches play in community organizations in Haʻapai. As Havea (2020) claimed, "almost all the population on Haʻapai are active members of a Christian church" (p. 198). This was evident, for example, during TC Ian in 2014, when church buildings were the main evacuation centres for approximately 4,000 people who sought shelter (International Federation of Red Cross and Red Crescent Societies, 2014).

TC Ian (discussed in more detail in Chapters 2 and 4) struck Haʻapai on the 11th of January, 2014, "flattening homes, uprooting ancient and valuable trees, destroying food crops and displacing thousands of families" (Food and Agriculture Organisation, 2014, p.i). In that year, the *WorldRiskReport* (Jeschonnek et al., 2014) ranked Tonga as the third most 'at risk' country in the world. According to Welle and Birkmann (2015), this Index considers "two different, broader categories of natural hazards: sudden-onset events like storms, floods and earthquakes, and creeping hazards as droughts and sea level rise" and "the core components of vulnerability namely susceptibility, coping and adaptation" (p. 4). The factors quantified in this index, such as "social networks" (Welle & Birkmann, 2015, p. 5) may not, however, accurately capture the complexities of kinship systems in Pacific Island nations such as Tonga or Vanuatu (Ratuva, 2014).

When contemplating the value of initiatives designed to "reconstruct [our] own [Pacific] educational identities" (Puamau, 2005, p. 25), the role of these kinship systems in children's learning in Tonga should be closely considered. Prior to European contact, "each family was responsible for the training of the children, and transmitting to them the things necessary for the preservation of their status in the societal structure" (Palefau, 2005, p. 19). For example, Tuna Fielakepa (2014) stated:

> Tongan children learn their culture through observing, listening and doing. It was the obligation of the parents, the family, the extended family, and the community at large to ensure that every child had the opportunity to experience the culture. In the first half of the twentieth century, Tongans enjoyed a close-knit society bound by extended families in which everybody knew each other's business. In this intimate society, I learned the art of *ngatu* [tapa cloth] production. (p. 326)

Handicraft production, particularly the weaving and selling of fine mats, is one of the main sources of income for people in Haʻapai (Tonga Ministry of Agriculture, Food, Forests and Fisheries, 2015). As mentioned, subsistence activities are a central part of life in Haʻapai. In 2015, there were 934 households in Haʻapai and out of these, 915 were reported to be actively involved in agriculture (Tonga Ministry of Agriculture, Food, Forests and Fisheries, 2015).

However, despite these statistics above, a recent study by Veatupu et al. (2019), reporting on the food consumed by Haʻapai children, provided a stark reminder that Haʻapai is not exempt from the effects of globalisation. Their study, which included the use of wearable cameras, found that "less than half (45.2 %) of all mixed meals observed were traditional foods … [highlighting] a transition from a traditional diet" (p. 1). Palefau (2005) also claimed that young Tongans are lacking in knowledge of traditional Tongan science and technology (such as skills required to grow food) and proposed schools needed to introduce relevant programs, such as a community apprenticeship program, to address this and preserve Tongan cultural identity. Consequently, it was this context of cultural change that formed a critical backdrop to my various talanoa with Year 10 science students in Haʻapai.

Talanoa with Haʻapai students (Year 10)

The data collection process for this case study (Chapter 6) involved a series of talanoa sessions with Year 10 (locally known as Form 4) students similar to that conducted with their Year 10 science teachers (as rationalised in Chapters 3 and 5). These talanoa sessions also took place in Heilala College (pseudonym) with two groups of Year 10 science students in 2015, a year following the destruction caused by TC Ian. I held organised talanoa sessions with two separate groups of Year 10 students at Heilala Secondary School in Lifuka, Haʻapai. Group M consisted of three males and two females from Mana's class and Group T had one male and three female students from Tōnunga's class. Students in each group were also from different villages and islands of Haʻapai, with four out of the seventeen inhabited islands of Haʻapai being represented in our talanoa, as illustrated in Figure 6.1 (below).

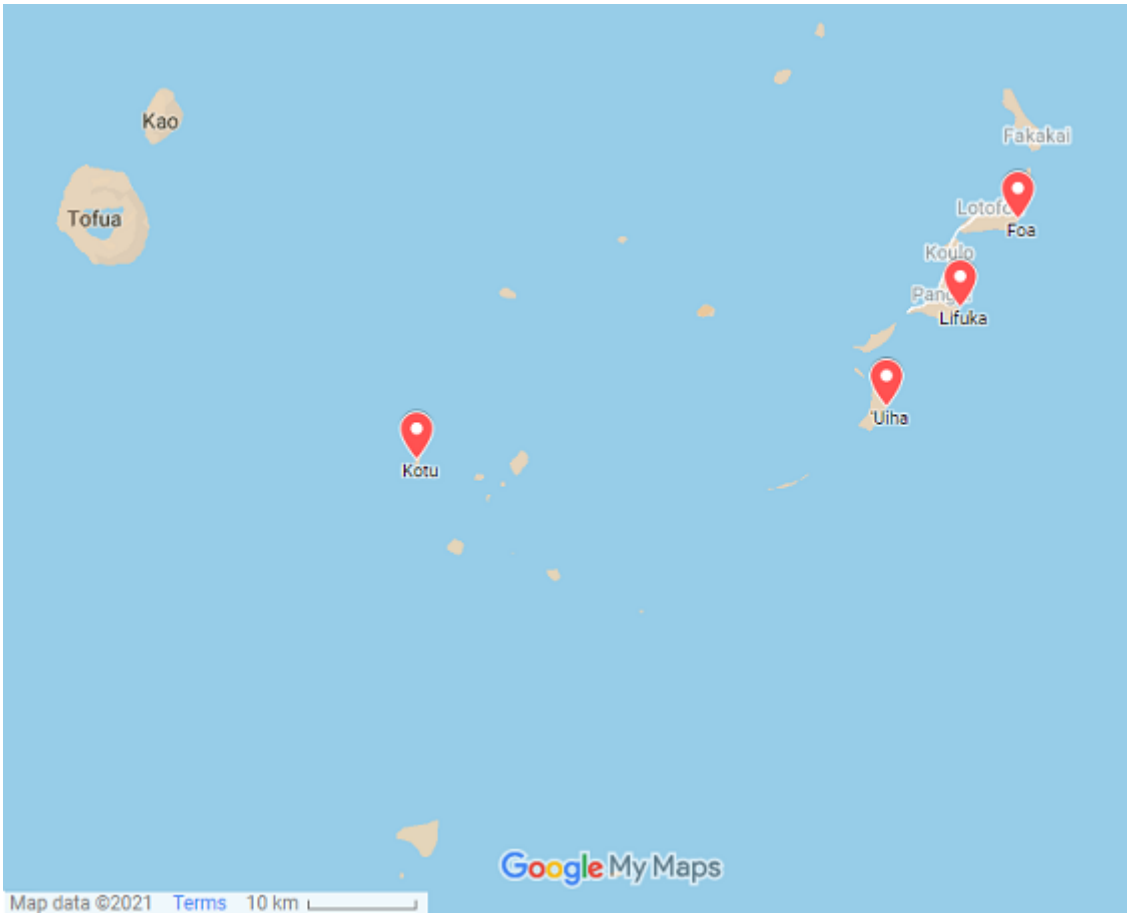

Figure 6.1: *The Haʻapai Island Group in the Kingdom of Tonga. Participants identified as being from the islands indicated with red markers. This map was adapted from Google Maps (n.d.-c).*

This brought a diversity of experiences to the group discussions, given the different biogeographical and social features of various villages and islands in Haʻapai. The majority of participants were from various villages on the islands of Foa and Lifuka, and these have been highlighted in Figure 6.2.

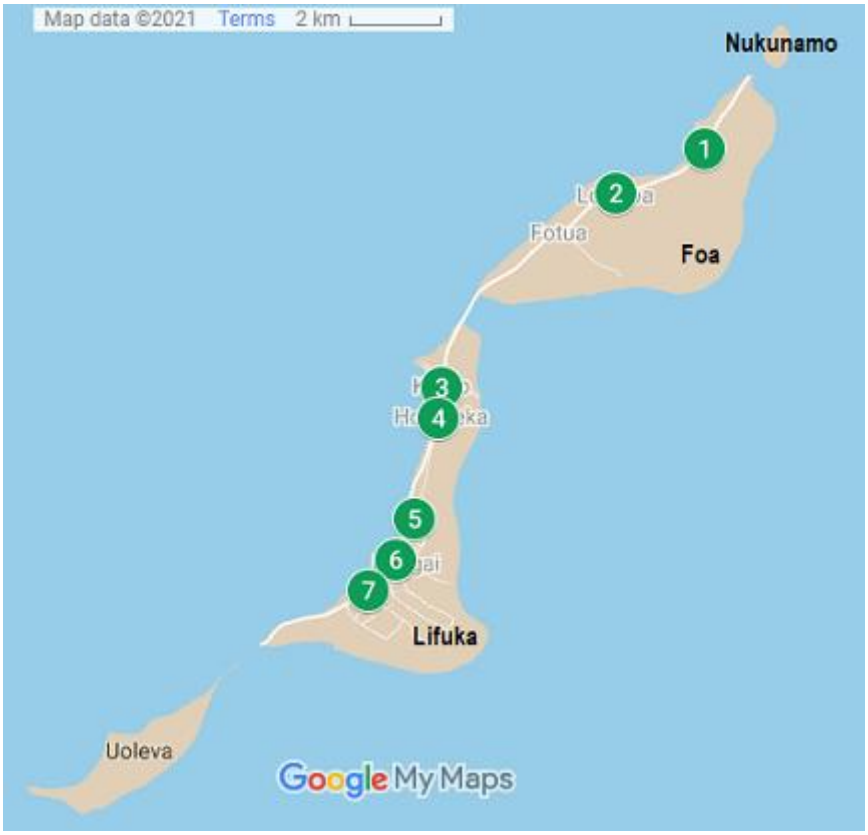

Figure 6.2: *The island of Lifuka (location of Heilala College) and neighbouring islands Uoleva, Foa and Nukunamo in Haʻapai (Kingdom of Tonga). The villages that participants from Lifuka and Foa identified as being from have been shown with numbered green markers:1. Faleloa; 2. Lotofoa; 3. Koulo; 4. Holopeka; 5. Pangai; 6. Haʻatoʻu; 7. Hihifo.*
This map was adapted from Google Maps (n.d.-b).

I had asked the participating science teachers in this study (Mana and Tōnunga) to select four students each to participate. This selection method was chosen due to the time I believed was needed to build trust with the students. Given I also had to consider time constraints posed by my limited resources and the time I could spend in the field, I requested both teachers to select student participants. However, when five students showed up for the talanoa from Mana's class, I did not question this, but invited all these students into the talanoa session. This was necessary for me as I wished to show fakaʻapaʻapa (*respect*) to the students and display gratitude for their willingness to participate.

The participating students all signed consent forms which indicated their participation was informed and voluntary in nature. I met with each group of students twice and invited them to approach me at their school (outside the talanoa sessions) if they had anything else they wanted to add to their recorded comments – with the benefit of hindsight and privacy.

Although I had planned prompt questions for the talanoa sessions, the fluid nature of the talanoa process prompted me to ask various questions in response to students' answers. I asked different questions in each group based on student responses to my previous questions and adjusted the pace of the talanoa according to what participants felt comfortable with. For example, students in Group T talked more extensively about their experiences of TC Ian and brought these up early in our talanoa. By the end of the designated time of our first talanoa session, we had subsequently discussed less questions than planned. However, this gave me insight into the students' experiences that I had not expected, such as details given by students about how they worked together with their families to secure their shelters during TC Ian and the impacts on local food and water security after TC Ian.

All my talanoa sessions with students were audio recorded, transcribed and carried out largely in the Tongan language. During my first talanoa session – with each group – I aimed to build relationships with participants to uphold cultural norms and values such as feveitokai'aki (mutual respect), integral to my ethical approach to the collection of data. In the Tongan culture, "age and genealogical relationships, especially the relationship of a sister to a brother, are sources of influence and power" (Young-Leslie & Evans, 2001, p. 10). I was consequently aware that in our Tongan culture youths are expected to respect adults by not answering back (Lee, 2016). I, therefore, made efforts to help the students feel they could openly share their opinions freely by using humour and endeavouring to show respect.

Having outlined these methodological and ethical considerations, the next passage of this thesis (Part Two) presents the findings from these talanoa sessions with students. As in the previous Chapter (5), participants' quotes are given in Tongan, with translations provided in English. While participants have been identified by their villages/islands of origin within Ha'apai, pseudonyms have also been used (again) to protect their identity.

Part Two: Findings from Ha'apai Students' talanoa

Similar to Chapter 5, the findings from the Ha'apai students' talanoa are presented under three thematic headings which capture the scope of our talanoa. These are (i) *Link between Social and Environmental Realities*, (ii) *Knowing the fonua* and, (iii) *Obligations in the fonua*. Findings from the talanoa are supported by excerpts from participating students' science notebooks which capture most of the content covered in their science classes.

Link between social and environmental realities

In her talanoa with Year 10 students in Ha'apai, Havea (2020) found they were connected to the sea through their reliance on it for sustenance and their families' incomes,

"essentially, their life is dependent on the sea" (p. 122). My own talanoa with the Haʻapai students participating in this study similarly found they made sense of their local environment by describing their own or other people's interactions with it. They also discussed whether they felt these interactions were causal factors in environmental degradation or responsive to changes in their environment. These stories might suggest careful consideration be given to the future development of multi-sensory (affective) learning activities where these young people can see, touch, smell, hear and taste the real scientific challenges facing them and their community.

This, in turn, inevitably requires official consideration and approval of learning activities that are to be performed "in" the environment, not removed from it (i.e. in a classroom). This would align with Situated Learning as described by Cakmakci et al. (2020) recognizing:

> If students were empty vessels no construction of knowledge would be needed; we could simply fill the empty vessel with knowledge. Instead, effective science instruction must recognise that culture and society frame both the knowledge a student possesses upon entering school, as well as the knowledge and skills the student is expected to obtain once in the classroom setting (pp. 296 - 297).

In the next section, below, I will now add weight to this argument by discussing two prominent environmental issues discussed by students in our talanoa, TC Ian and coastal changes.

TC Ian – Afā ʻIeni. The resilience of Haʻapai families became increasingly evident when the students shared their stories about personal experiences of Category 5 TC Ian. This cyclone struck Haʻapai on 11th of January 2014 – destroying crops, homes, and further compromising water security as it came at a time of drought. Sea salt spray further contaminated the already limited water supply (Government of Tonga, 2014). The Haʻapai students, therefore, gave vivid accounts of (learning) experiences they shared with their families during TC Ian. Students learned with their families how to:

(i) respond to cyclone warnings.

(ii) evacuate and find shelter in secure buildings.

(iii) secure their property before a cyclone, as well as how to clean up afterwards; and,

(iv) respond to food and water security issues in a time of post-disaster drought.

Some families had to evacuate together to nearby shelters, such as a church building or a school alumni hall. Families also displayed collective resilience by working together to stay

safe and respond to the dangers at hand. This is an example of collective sharing of Tongan people's burdens and meeting each other's needs, especially in the context of their own kāinga (wider family). One student, Ishaani, had evacuated with her brother and parents to a hall during TC Ian and she told me how their home was destroyed:

> **Ishaani (Heilala College):** Talu ʻeku nofo he efiafi ko iá mo ʻeku fakaʻamu ke u fai mo aʻu ki heʻemau ʻapí pea ko e hā meʻa ʻoku hokó. ʻOhovale au he aʻu ange ʻeku tamaí … talamai ʻosi maumau kātoa ʻa e ʻu meʻa ʻi ʻapí … Pea holoki leva ʻemau ʻapi ʻa mautolu ko iá ka mau nofo teniti, ʻa e fanga kiʻi teniti, ko e tokoni ko e Red Cross. Pea mau nofo teniti, ʻuhinga kae ... ko e kui ʻaʻakú. ʻOku ʻi ai ʻene fānau ʻana ʻoku tokolahi ʻi muli ka ʻuhinga naʻa nau tā mai nautolu ʻo ʻai ʻa e kautaha ʻi Tonga ke nau haʻu ʻo ʻai e fale pea, pea haʻu nautolu toe langa foʻou emau ʻapí.
>
> ***Translation:*** *That whole afternoon I wanted to hurry up and get back to our home to see what is happening. I was surprised when my Dad came … he said everything at home was damaged … Then our house was demolished and we stayed in tents, these tents that Red Cross had donated. So we stayed in tents, because then … my grandfather. He has many children overseas, so they contacted a company in Tonga to come build our house, and then, they came and rebuilt our home.*

This quote (above) highlights the widely held Tongan view that resilience is not about individualism, but rather it reflects a collective effort and ʻofa (love) played-out on local/national and trans-national stages. For example, research by S. Tonga (2020) found that South Auckland Tongan community "kalapu kava-Tonga [kava clubs] adopted the idea of toungāue fetokoniʻaki (cooperative fundraising task) to their advantages" (p. 71) by helping different kava clubs fundraise for remittance projects to send back to specific villages in Tonga. In Tonga, gifting remittances is understood culturally as an expression of ʻofa (love) and "no-one can be forced to love, because ʻofa is something that comes from the heart … People are encouraged to practise the notion of love [ʻofa] through remittance fundraising" (Tonga, 2020, p.89).

My talanoa with students drew attention to the fact local families also faced water and crop shortages. Access to freshwater also remains a problem in Haʻapai as it has lower than normal rainfall during the dry season. This can lead to drought conditions if prolonged (Mailau et al., 2007). Food security and consumption patterns were, similarly, impacted by TC Ian. This dramatically disrupted the subsistence lifestyle of Haʻapai families and, according to the Food and Agriculture Organisation (2014) , immediately after TC Ian, the supply of local food and key cash crops were projected to be "completely paralysed for the next six to ten months" (p. iv). Jasmine, subsequently shared this following account of her family's farming activities in the recovery period:

Jasmine (Heilala College): ‘Osi ‘a e afā, pea ‘alu atu ‘emau fāmili ki ‘uta, ‘oku holo e ‘ā ia ... ha‘u e fanga pulú ki loto ke kai ‘emau ngoué. Pea toe ‘ai fo‘ou eni e ngoué. Pea ko e ngoue na‘e tō, ‘uhinga na‘e tō pea teuteu ko ē ke kaí, pea afā, pea ‘ikai ke foha lelei ... Pea toe feinga‘i leva ke ‘ai e ‘ā fo‘ou ‘o toe tō e ngoue fo‘ou ki ai ke mau ma‘u me‘atokoni mei ai.

Translation: *After the cyclone, then, our family went to the plantation, and the fence had come down … the cows had come inside to eat our crops. So now we have redone our plantation. And the crops that had been planted, they had been planted and were ready to be harvested, then, the cyclone hit and the yield was not good … Then we tried to put up a new fence and planted new crops as food supply for us.*

Although unsaid, we can only infer that Jasmine has learnt agricultural skills from helping to tend to her family’s plantation to secure their food security and their food sovereignty. Ishaani, likewise, described similar food security and food sovereignty challenges facing her family. This was especially evident when she said:

Ishaani (Heilala College): Na‘e honge ‘a Ha‘apaí ni, ‘uhinga honge fakame‘akai ... tuku kehe pe me‘akai mei mulí na‘e ‘omai pē ia, ka koe honge fakame‘akai ko ē mei ‘utá.

Translation: *Ha‘apai had a shortage, I mean a food shortage … apart from the food imported from overseas, that was still brought in, but we had a shortage of crops from the plantations.*

One student believed that more people in his village had planted crops after the cyclone so that they could eat them. Elsewhere in the Pacific, such as Hawai’i for example (which imports 90% of its food despite having fertile land), significant efforts are now also being made to reclaim food sovereignty, engaging youth through Indigenous education initiatives in producing traditional crops such as taro (Meyer, 2014). Youth possessing the knowledge to grow their food locally avoids excessive packaging and transport of imported foods and ensures family held knowledge of food security and connection to the land is maintained.

At the time of our talanoa, students had not yet covered the *Planet Earth and Beyond* unit (Tonga Ministry of Education and Training, 2015) in their science classes. In this unit students would eventually learn about natural disasters. The Tonga Year 10 science syllabus also states that students should be able to “describe appropriate advice or guidelines to follow before, during, and after cyclones, earthquakes and tsunamis” (p. 41). As a result of my talanoa with Ha‘apai students, and learning about their lived experiences of life after TC Ian, I am convinced that the inclusion of *Natural Disasters* in the *Planet Earth and Beyond* unit (Tonga Ministry of Education and Training, 2015), from Year 9 to 11 is logical, given that Tonga was ranked No. 3 in the *WorldRiskReport* in 2020 (Kirch et al., 2020). Yet, as Ratuva (2014) has

also highlighted these lived experiences are often overlooked by those with the power to make significant policy decisions:

> The Pacific Island states are ranked on the lower end of the global stratification because in most cases, the measuring variables used are culturally, historically and ideologically biased in favour of neoliberal and Western paradigms and tend to ignore the worldviews and unique cultural dispositions and historical realities of subaltern post-colonial communities (p. 41).

Based on my review of the literature, and interactions with teachers and students in Haʻapai, I would add that the local knowledge Pacific communities hold – especially regarding adaptive and/or recovery measures in the face of natural disasters – may be too quickly dismissed by scientists and not considered as part of disaster risk reduction. This, accordingly, may result in strategies that ignore valuable community resources (i.e. traditional knowledge) and overlook the diverse needs within each of these communities.

This approach tends to favour 'outside' knowledge and ignores the complex diversity of needs found within communities across the Moana (Mercer et al., 2012). A study on perceptions of TCs in Fiji, Vanuatu and Tonga has, for example, found that "younger respondents were more likely to suggest that TC information could be improved, whilst older respondents were generally happier with the information they receive" (Magee et al., 2016, p. 1102). This finding clearly suggested that those youths who participated in this study may well experience catastrophic events in differing ways from the adults in their communities. Therefore, in the Pacific, it is key to consider whether/how local or Indigenous knowledge can be ethically and effectively incorporated into teaching and learning about natural disasters in school curricula so that it is accessible to future generations.

As described previously (Chapter 5), Year 10 science students in Haʻapai usually copy notes that teachers have written on the blackboard. Their teachers have compiled these notes from various sources to teach students the content of the prescribed Tongan syllabus. From my review of some students' notes on natural disasters (written in their note books), I did, however, find evidence of a teacher seeking to blend her TEK with the western science otherwise dominating the texts prescribed for her students. For example, Mary Bell (pseudonym), a student in Tōnunga's class, had science notes from the 22nd of October, 2015, which outlined long-term preparation activities before and after the cyclone (TC Ian). The trees she suggested should be planted as "buffer trees", at a distance from the house, were all native plants. They were, moreover, listed with their names in the Tongan language, and divided into the following categories:

a. edible trees: vī, mango, ifi, mei, etc
b. medical trees: manonu, nonu
c. scented trees: mohokoi, langakali

The herbaceous plants she recommended be planted right next to the house included edible ones and (again) those of medicinal value. These included hēhea (*Syzygium corynocarpum*) and fiki (*Jatropha curcas* L.) (Latin names sourced from Weiner (1970). For the purposes of 'recovery', Mary Bell's notes also recommended grating fallen or uprooted crops and using these for baking, and storing broken branches and trees for firewood. Again, this shows how a teacher (Tōnunga) has attempted to incorporate Tongan language and TEK to contextualise the science curriculum, a move to be commended given that the offical syllabus does not require this.

Further evidence of this contextualisation could be found in relation to Mary Bell's *Planet Earth and Beyond* notes (22nd of October, 2015) on cyclone recovery strategies. She stated: "Replant crops quickly, *manage properly after cyclone relief … you help yourself." I would interpret this extract to reflect a concern for food security and food sovereignty as discussed earlier regarding the need to avoid youth becoming even more reliant on overseas food supply. The consumption of cheap, energy-dense nutrient-poor imported food was already noted as a problem among Haʻapai children (Veatupu et al., 2019). Thus, the health and environmental benefits of eating healthy and locally produced food cannot be overstated.

As the world faces the Covid-19 pandemic, in Tonga we are also facing our own Pacific epidemic of obesity and non-communicable diseases such as diabetes. This is in part due to a more sedentary lifestyle and a shift towards a modern diet. There is potential to explore authentic learning approaches (as discussed in Chapter 5) to the written advice provided in classes to ensure all students are given the opportunity to practise and participate in traditional Tongan knowledge and skills to resist this alienation from land, sea and traditional diets. As Palefau (2005, p. 400) has suggested, traditional Tongan science including agriculture and fishing – can be taught in schools through "authentic hands-on activities" and would require schools to collaborate with communities and provide necessary equipment for these.

Changes along the coastline. In Basso's (1996) ground-breaking ethnographic work with Western Apache people, an elder explained to him the significance of place names and how wisdom 'sits' in places. The elder explained the logic of this by taking him to a place where he told Basso: "It looked to them [our ancestors] then as it looks to us now. We know that from its name – its name gives a picture of it, just as it was a long time ago … You can see for yourself. It looks like its name" (p. 12). This proposition resonates with me because it

exemplifies how Indigenous peoples' wisdom can be passed down the generations through Indigenous place names – which serve as mnemonic prompts. I also encountered this sort of prompting, in narrative form, during my interactions with students in Haʻapai. Ishaani, for example, explained to me the meaning behind the name of her village, Tongoleleka, as follows:

> **Ishaani (Heilala College):** Naʻe lahi ʻa e tongó ʻi Haʻapaí ni ... ʻoku ui ʻa Hihifo ko Tongoleleka .... ka naʻe fele ʻa e tongo ʻi he kiʻi feituʻu pē ʻi Hihifo ko Toluafe. Ko e kiʻi meʻa naʻe ui ai ko e Tongoleleká, ko e kiʻi motuʻa naʻe ... ʻave ia paniʻaki hono ʻulú ʻa e tongó ʻuhinga ko ʻene fie lekeleka ... Pea ʻuhingá naʻe lahi e tongó. Ko taimí ni ia, ʻikai ke toe ʻi ai ha tongo ʻi Haʻapaí ni.
>
> ***Translation:*** *There were a lot of tongo [mangroves] in Haʻapai … The village Hihifo is called Tongoleleka eh ... but there were many tongo in a place in Hihifo called Toluafe. The reason why it's called Tongoleleka, because of a man who went and dyed his hair with the tongo because he wanted to be lekeleka [young] … Because at the time there was plenty of tongo. But now, there is no tongo in Haʻapai.*

This story best demonstrated my experiences of the Haʻapai students' familiarity with the oral histories of their place. It became a signpost to me that something had happened, not only to change the coast but people's relationship with it. This was significant because, during our talanoa, I soon found the students wished to discuss changes along the coast mainly in terms of three activities, (i) the cutting-down of mangrove and other coastal vegetation; (ii) sand mining to obtain sand for construction purposes and covering graves; and, (iii) the construction of the foreshore in response to sea level rise. For example, in response to my question about changes noticed in their villages, the students often gave vivid descriptions. Here, below, are a series of examples they provided of the changes that concerned them. Place names mentioned can be found on the map in Figure 6.2.

> **Ishaani (Heilala College):** Hihifo foki ʻoku tuʻu ʻa e fale mahaki. ʻOku ʻosi fokotuʻu ʻa e foasoa ʻi fale mahaki he ʻe ʻalu pe taimí ia, ʻe aʻu mai ʻa e tahí ia ki he fale mahakí.
>
> ***Translation:*** *Hihifo is where the hospital is located. A foreshore is already constructed [in front of] the hospital because as time goes on the sea will eventually reach the hospital.*

> **Jasmine (Heilala College):** Te u kamata pe mei he tahi … ko ʻemau sio pē ki uafu he foasoá … hangē ʻoku rise e lēvolo ko e tahí he taimí ni ki ʻolungá. ʻA ia, ʻokú ne hanga ʻe ia ʻo kai mai e fonuá ʻo mei aʻu mai e tahí ki ʻofisi ʻoku tuʻu ko ē ofi ki he matātahí … Pea mo e ngaahi ʻakau ko ē matātahí. Lahi ʻalu ʻa e kakaí ʻo tā e ʻakau mo e meʻá ia, ke langa ʻenau falé. Ko e meʻa pē ʻe iku haʻu ʻa e tahí ia ke haʻu ki he fonuá ʻikai ke ʻi ai ha ʻakau ia ke tuʻu he matātahí. Pea mo e ʻoneʻone pē. Ko e toe

ʻalu e kakai ia ʻo tata e ʻoneʻoné ka ʻikai ke tuku e ʻoneʻoné ke taʻofi ʻe tahí kae haʻu nautolu ʻo tata e ʻoneʻoné ke siʻisiʻi kae haʻu e tahí ke kai e fonuá.

Translation: *[Describing Pangai] I will start from the sea … when we look at the wharf from the foreshore … it seems that the sea level is now rising. So it is eroding [literally eating] the land and the sea almost reaches the offices which are near the shore … And the coastal vegetation. The people often cut down the trees to build houses. What happens is that the sea will approach the land and there are no coastal vegetation there. And the sand. The people also remove the sand but they don't leave it there to stop the sea but they remove the sand, not leaving sand to stop the approaching sea but instead they go remove the sand, leaving only a small amount and then the sea comes to erode [eat] the land.*

Fifita (Heilala College): Ko e vahaʻa ko ē mei Faleloa ki Nukunamó … Ka ko e taimí ni ia, ʻoku taimi ʻoku mamahá ʻoku ʻikai ke toe pakupaku, ʻoku anoano pē ia, vai pē ia.

Translation*: The space in-between Faleloa village and Nukunamo island … Now, when it is low tide it is not dry anymore, it still has sea water there*.

Viliami (Heilala College): Talu eku tupu hake naʻe fakaʻofoʻofa ʻaupito e matātahí, naʻe ʻi ai ʻoneʻone ai ... ʻosi maʻa ʻoneʻoné, ʻosi ʻasi hake ʻa e maka ʻi laló. Ka ʻoku ʻosi aʻu, ʻo ʻosi ... ko e ʻulu ʻakaú ia … naʻe hanga e tahi ʻo taʻaki ʻa lalo. Holo ia.

Translation: *[Describing Lotofoa] Since I grew up, the coastal area was very beautiful, there was sand … the sand is gone [now], the rock beneath is already showing. And it has already got to a point … the trees … the sea uprooted them from beneath. They have fallen down.*

The descriptions above, so rich in detail, demonstrate the students' high levels of place consciousness and their Indigenous knowledge of place (i.e. their villages and ecological surrounds). It was significant, therefore, to also note that these students did not explicitly link sea-level rise or the coastal erosion with climate change, but rather focused on the need to undertake local actions to tackle problems, such as coastal deforestation. Previously, Havea (2020), also found that Haʻapai students as well as teachers did not seem to blame industrialised countries for climate change, but rather focused on local contributors to climate change, such as "burning rubbish and cutting down trees" (p. 264).

However, there are non-climatic factors affecting the coast in Haʻapai, which, combined with sea level rise, make coastal erosion a complex part of the students' lived realities. For example, a 7.9 magnitude earthquake (3rd of May 2006) resulted in Lifuka subsiding by 23 cm. This, in turn, has intensified the effects of coastal erosion (SPC, 2014) .

Also, it is worth considering how coastal developments such as the Pangai wharf and the Foa causeway (which connects the neighbouring islands of Lifuka and Foa Islands) could cause further coastal erosion by disrupting natural sand transport (SPC, 2014).

When I asked students if they believed that the changes in Haʻapai could be reversed, they shared the following contrasting views (below), but still remained focused on discussing the need to take local actions – rather than discuss the faults of overseas industries:

> **ʻAlatini (Heilala College)**: ʻIkai ke toe lava ia fakafoki he ʻoku fai e tata e ʻoneʻoné ke langa ʻa e ʻu fale koloá.
>
> ***Translation:*** *It cannot be returned because people mine sand to use in building shops.*

> **Fifita (Heilala College):** ʻIkai ke toe lava ia fakafoki … Tonu pē ke faʻu e lao ia ki ai. Ko e ʻuhingá ke fakasiʻisiʻi hifo e tā ko ē ʻulu akaú, hoko ai ngaahi palōpalemá mo e tata e ʻoneʻoné. Kae ʻikai foki ke lava ha taha ia taʻotaʻofi tata e ʻoneʻoné. Fiemaʻu vivili ia e kakaí ki he - ke lava ʻenau ngaahi fiemaʻú.
>
> ***Translation:*** *It cannot be reversed … We should make a law about it. The reason being, to limit cutting down trees, which causes problems and the removal of sand. But nobody would be able to stop the removal of sand. The people persistently want for – to fulfil their desires.*

> **Pita (Heilala College)**: ʻIo, e lava pē ia, kae tō pe tongó ke lahi. Te ne hanga maluʻi e fonuá.
>
> ***Translation****: Yes, it can be done, but we must plant lots of mangroves. They will protect the fonua (land).*

> **Mary Bell (Heilala College):** ʻIo, ʻaki ʻetau hanga pē ʻo tō e ʻakau hangē ko e tongó mo e u ʻakau lalahi ko ē he matātahí mo fakasiʻisiʻi pē hono tata e ʻoneʻoné.
>
> ***Translation:*** *Yes, by planting plants such as mangroves and big trees at the shoreline and limiting the removal of sand.*

The suggestions made by these students are also interesting in that they tend to align with an *Ecosystems Based Adaptation* (EbA) approach to climate change, which contrasts with conventional approaches to coastal erosion. As Pedersen Zari et al., (2019) explained:

> ... a typical response to coastal erosion, exacerbated by climate change, might be to erect a seawall. While this may solve the primary problem, it may be expensive, is often temporary, and does not address the drivers of coastal erosion such as vegetation loss … an EbA approach might be to revegetate, protect, or restore native coastal

> ecologies. This reduces erosion, but also maintains culturally significant relationships between people and foreshore ecologies, and increases the amount of ecosystem services locally. This in turn increases communities' resilience to climate change as well as other environmental changes. Secondly, EbA approaches to climate change often reveal through initial analysis of drivers of changes to ecosystems that multiple interconnected drivers of change come from both climatic changes and also from the activities of local people (Mackey et al., 2017; McPhearson et al., 2018). (p. 2).

As a core principle of EbA approaches to climate change, it is worth further noting that EbA incorporates (western) science and local knowledge as explained, here, by Mercer et al., (2012):

> Local people can hold vast amounts of information and experience of their environment built up over countless generations … Building upon local knowledge and non-infrastructural, or "soft" approaches is potentially more cost effective and accessible by poor and/or rural communities than measures based on purely external interventions or those highlighting engineering infrastructure [19–21]. (p. 1910)

EbA, as a result, is a process which aligns with the thinking of the Haʻapai students I met, because it "recognises that man and society are integral parts of ecosystems", thus highlighting the link between cultural action and ecosystem health (Andrade Pérez et al., 2010, p. 16). This, furthermore, aligns with the concept of fonua in Tonga, which was well known to the Haʻapai students. This concept (fonua) alludes to a notion of land/country. However, fonua also refers to the placenta, which nourishes the unborn baby in the womb. It is also a common Tongan practice to bury the placenta of a baby and plant a tree with it. Tongans are therefore born from a fonua (placenta), to a fonua (land/place) and upon death they enter the fonua loto or grave (Māhina, 1999 cited in Kaʻili, 2005). Kaʻili (2005) further explained this as a mutual relationship: "Within this mutually beneficial reciprocal relationship, people take care of (tauhi) their land, and in return, the land nourishes its people" (p. 93).

When threats of climate change face communities in Tonga, it is, accordingly, important to view these threats through the cultural lens/perspective of fonua, and to consider the reciprocal relationship, described by Kaʻili (2005). Hence I would suggest here and elsewhere in this chapter that EbA approaches to climate change ought to be considered in future science curriculum reviews, as also discussed later in this chapter.

Knowing the fonua

Students recognised there were multiple sources of knowledge about the environment. When considering how they would find out something they did not know (a mystery) about the environment students had different strategies. Similar to some Port Vila students, Haʻapai students also considered the Christian God as a source of knowledge regarding the

environment. In Group M, Viliami from Lotofoa village suggested "lotu" (to pray) which was in a similar vein to the suggestion given by Jasmine from Pangai about asking "Tamai Hevani" (Heavenly Father) for help. She later added on that another way was to study more to know more about it and go out and search for the answer in the environment, for example if it was a mystery at sea, go out on a boat to the sea. This aligns with other students in Group M, when I gave an example asking how would they find out how much the sea level had risen, participating student Sally suggested "a'u tonu pe 'o fua" (to go directly and measure).

These references to relying on God were also found by Bender (2002) in research in Ha'apai, where "according to the environmental model of many Tongan fishermen, God is held as creator of and provider for both fishermen and fish" (p. 60). Bender believed that this was used as an excuse for overfishing. However, Ishaani provided a different perspective of how environmental threats, such as TC Ian, and belief in the Christian God interact in response to my question about what they thought would be important for everyone in Ha'apai to know about the environment. She responded:

> **Ishaani (Heilala College):** Ke nau teuteu, 'uhinga na'a 'ohovale pē 'oku - hangē ko e tō mai 'a e afā ko ē 'Ieni ē? Na'e tala mai pē he letiō, ka na'e 'ikai ke fu'u fakapapau'i ia. Ka na'a nau toki 'ohovale pē nautolu he tō mai afaá. 'Ikai foki ke nau lava pule'i, he ko e pule ia 'a Sihova, ki he me'a kātoa. 'Uhingá, fie ma'u ke nau 'ilo 'e nautolu 'u me'a ko iá 'uhinga ke nau toka teu, hangē ko e lau ena, toka teu ki ha fakatu'utāmaki e hoko mai he … kaha'ú.
>
> ***Translation:*** *For them to prepare, because in case it – like when Cyclone Ian hit, eh? It was announced on the radio, but it wasn't confirmed. Then they were surprised when the cyclone hit. They cannot control it, only Jehovah [the Lord] is in control of everything. So, they need to know those things so they can prepare in advance, like that saying goes, be prepared for any danger that will come in … the future.*

Ishaani draws a line between the power of Jehovah (another name for the Christian God) and humans which leads her to the conclusion that disaster preparedness is essential. As a point of similarity, Port Vila students also recommended that people need to heed cyclone warnings and take measures to prepare for these.

When I asked Ha'apai students whom they thought knew the most about the environment (using the word 'ātakai) and whom they could trust to ask about the environment, they responded by listing people who held traditional knowledge as well as others who held scientific credentials.

> **Viliami (Heilala College):** Kau tama ko ē matu'otu'a he koló mo e kau tama pē na'e 'osi nofo fuoloa ai, na'a nau tupu hake [ai].

Translation: *Those who are mature in the village and those who have stayed there for a long time, they grew up [there].*

Jasmine (Heilala College): Falala ki he kakai ko ē nau ʻosi ako fekauʻaki mo e ʻu climate change mo e meʻá pea nau ō mai ki Tongá ni ʻoku nau māʻolunga ai, ʻa ia ko e kakai nau ngāue he meʻa ko e ʻātakai kau sioloki mo e haa … Kakai te falala ki ai ke te ʻeke ki ai ha fehuʻi fekauʻaki mo e environment

Translation: *Trust the people who have already studied about climate change and stuff then come to Tonga and are high up, they are the people who work at the Environment [Department], the geologists and others … They are the people to trust and ask any questions about the environment.*

Yet, later, when I asked one group of students if there were any scientists who knew more about Haʻapai's environment, they quickly responded "no". They resolved they would ask people who worked in the Haʻapai branches of government departments related to the environment.

The Haʻapai students who participated in my talanoa described their environment in universal terms as well as through very place-specific knowledge, often organised around their villages as a social unit. This demonstrates that students build their knowledge of the environment through lived experiences and conversations in their familial/ecological settings and, to a lesser extent, schooling. Hence, I believe that the concept of fonua (land and people being inseparable) meaningfully captures the students' view of the local environment plus its embedded ethics. The meaning of the concept fonua is described by Taufeʻulungaki (2004) as:

> The concept of 'health' … means the well being of the whole person: that is his/her spiritual, mental and physical well being, which is an interpretation that is consistent with the Pacific's holistic worldviews. Well being and health refer not just to individuals but also to communities, the environment in which they live, and the relationship that binds them together. This set of interdependent relationships is what I meant by 'fonua' in Tongan, 'vanua' in Fijian and 'whenua' in Maori. In other words, 'fonua' is a Pacific concept of community. (Taufeʻulungaki, 2004, p.3 as cited in Tuʻitahi, 2004, p. 19)

How did students conceptualise knowledge of the environment? Village elders were identified to be the most informed holders of such place-specific knowledge. In response to my question in Group T asking if students believed there were still things about the environment we didn't know, Jasmine responded that only God knew everything. Ishaani affirmed this but also pointed to the value of village elders' knowledge:

Ishaani (Heilala College): Hangē ko Hihifó ʻoku lahi ai e matangá. Ko e matanga ʻe taha ko ʻOnemato … ka ko e ʻuhingá ʻoku ʻikai ke te ʻiloʻi pē heʻete ʻalu atu ʻo sió

‘uhinga ko e ‘Oné ē, ko e Mató ē ... ‘aonga ke te toki hanga kita ‘o ‘eke ki ha toko taha pē ‘okú ne ‘ilo.

Translation: *Like in Hihifo village, there are many historic sites. One site is ‘Onemato … but my point is you won’t know just from going and seeing – that is ‘One and that is Mato .... it is better for you to ask someone who knows.*

Jasmine further emphasised that the elderly are the ones who know. This again reminded me of Basso’s (1996) proposition that ‘wisdom sits in places’ (i.e., with the elders). It was no coincidence, for example, that Ishaani spoke of the land in Ha‘apai as being like a book to be read (hence stressing the importance of eco-literacy), and that it must be explained by someone who already knows this ‘book’ (the village elders). This linking of place to story, genealogies and history also typifies the traditional Tongan view of history, elsewhere referred to by Lātū (2017) as Tala-e-fonuá, or “land-based tradition passed down from the ancestors” (p. 134).

It should be noted that in Tongan secondary schools, a subject focusing on Tongan culture is titled Tonga mo e Anga Fakafonuá (Tonga Society and Culture), which is taught in Tongan but is separate from Lea Faka-Tonga (Tongan language subject). While it was beyond the scope of this thesis to explore how environmental understandings are presented in these syllabi, I believe it would be worthwhile to conduct future research across curriculum areas to explore how Tongan students’ cultural values inform their view of the environment in relation to these western knowledge disciplines.

My interest in such further research was prompted, to some degree, by the Ha‘apai students’ responses to a hypothetical scenario I posed to them. Here, I asked whether they believed their father would ever be able to sell their family land to foreigners if offered a large sum of money? As is evident in the examples provided below, the students highlighted the concept of tukufakaholo (defined later) in their responses, claiming it (fonua) must be kept and cared for and not traded for money:

Fifita (Heilala Colelge): ‘Ikai. ‘Uhinga e ‘osi pe pa‘anga ka ‘e kei tu‘u pē ‘a e kelekelé.

Translation: *No. Because the money will run out, but the land will still stand.*

‘Alatini (Heilala College): Hela e matu‘a taimi ko ē, feinga ke ma‘u ha ‘api. Tauhi e tukufakaholó.

Translation: *The elders in the past struggled to get land. Take care of the passed down inheritance.*

> **Ishaani (Heilala College):** Kapau ko e ki‘i ‘api ko iá ‘oku kanisa pa‘anga ē, te nau lau pe nautolu ko e - koloa ke ‘omai e sēnití … Kapau ko e ‘api ko iá ‘oku nau tauhi e tukufakaholó e fāmilí, 'ikai ke nau hanga nautolu, ‘ikai ke nau lava nautolu ‘o fakatau ‘a e ‘apí ... ‘a e kelekele ko iá. ‘Uhingá, ko e kelekele na‘a nau tupu hake aí.
>
> ***Translation:*** *If that ‘api [meaning family] is greedy (literally has cancer of money), they will consider it a gain to get money. If that family takes care of the passed down inheritance of the family, they would not, they could not be able to sell the ‘api [meaning home/allotment] … that land. The reason being, they grew up on that land.*

Interestingly, these students’ views regarding the temporary nature of money compared to the land, was clearly echoed by those Year 10 science students of Port Vila, who also participated in this research (see Chapter 8). These findings are reminiscent of previous researchers’ findings on Ha‘apai people’s view of biodiversity:

> For the people of Ha‘apai, “biodiversity” is not just a matter of scientific, economic (in monetary terms), recreational or ecological value. It is a capital inheritance that has been passed on, relatively intact or in some cases enhanced, by past generations to current generations. Biodiversity is not income to be spent or destroyed … (Thaman et al., 1996 as cited in Tonga Department of Environment, 2004, p. 3)

I also found it interesting that, in Ishaani’s answer (see last quote above), the word ‘api was used to represent both the family living on the land and the land itself. This is consistent with Lātūkefu’s (1967) use of ‘api to mean household (among other things) and his observation that “like many other Tongan words, ‘api’ has several other meanings. It can refer to the block of land occupied by the household. It can also refer to the tract of land owned by an ‘ulumotu‘a [head of an extended family unit] and his fa‘ahinga [extended family unit]” (Lātūkefu 1967, p. 3). I believe the above descriptions, given by students, emphasise their family’s “interdependent relationships” (Taufe‘ulungaki, 2004, p.3 as cited in Tu‘itahi, 2004, p. 19) to the land they live on, requiring reciprocal care.

Two students, likewise, raised the concept of tukufakaholo, which Churchward (1959) defines as “handed down from generation to generation, or from predecessor to successor, hereditary” (p. 508). While these students were referring to the land, the meaning of tukufakaholo can be better understood in its wider use in Tongan society. For the purposes of Palefau’s (2005) research, it should be noted that he translated the concept of Indigenous knowledge and skills as “ngaahi ilo mo e founga faka-fonua ‘o e tukufakaholo motu‘á” (p. 484). To further clarify, Palefau (2005) explained how these are orally passed down from generation to generation:

> The transfer of TKS in Tonga occurs largely by oral means. Tongan elderly generations are always telling their family history orally, and Tongans are often very skilled in oral presentations such as telling stories, myths, proverbs, poems and family histories. They express their love, appreciation, beliefs and feelings orally and through music and poems (p. 107).

From my perspective, all of these indicate the potential for Tonga's science teachers to engage with the existing (offical) guidelines of teaching environmental values via a Tongan traditional lens like talatukufakaholo (oral traditions). Recognizing the value of talatukufakaholo is nothing new in Tonga, but as Palefau (2005) pointed out, this is done by elders. I wondered whether science teachers could also be part of this 'passing on' of traditional Tongan knowledge and skills and why or why not? While this may seem well beyond the official requirements of a science teacher's workload, such a stance could mitigate the risks of encroaching globalisation, which Thaman (2003) explained "concerns the global spread of mainly Anglo-American knowledge, values, and practices, rather than Indigenous knowledge and wisdom" (p. 7).

Hence I am inclined to believe that Pacific teachers of science must not remain silent about the way rampant consumerism in the West has driven environmental degradation in our own communities. As Bowers (2001) asserted, "the marginalization of culture as a major contributor to environmental degradation is matched by a collective silence about the nature of cultural practices that have a smaller environmental impact" (p. 144). Perhaps, by taking up this challenge, we Tongan teachers of science can "be creators/builders of knowledge as well as transmitters of knowledge … grounded on … the core values of Tonga" (Johansson-Fua, 2008, p. 3). Perhaps inspired by these Ha'apai students, science teachers in Tonga may realise our duty to "tauhi e tukufakaholo", maintain or guard what has been passed down, knowledge of the fonua.

Obligations in the fonua

Churchward (1959) translated the word fatongia to mean obligation or duty. Havea (2020) acknowledged that while her participants may have been unfamiliar with the scale of industrial activities overseas, they also had a strong sense of fatongia:

> Findings from this study also indicate the significance of fatongia (responsibility/duty) in addressing climate change in Tonga. Students and teachers believed climate change is in the hands of both the Government and the people of Tonga. They highlighted that the Government, the Ministry of Education, schools, the local communities and individuals must play a role in addressing climate change. (p. 266)

In this research, I have similarly explored students' perceptions of their obligations in relation to the environment surrounding them. To commence this discussion, it is worth recalling how Lafitani (2011) presented the concept of fatongia (obligation) as a worldview with the aim of fiefia (happiness). One example of how fatongia can inspire positive environmental action is through village inspections. Students told me that in Haʻapai, the Governor's office organises village inspections, which residents prepare for by cleaning up their properties together. This sense of collective obligation seemed to influence many Heilala College students (such as Pita, Viliami and Sally) who focused on fatongia as involving things like proper waste disposal, picking up rubbish and minimizing burning rubbish.

However, age also seemed to play a role in determining how students believed their environmental actions would be perceived by others in their communities. Fifita, for example, believed her responsibility would be to gather people to join her in picking up rubbish. However, when I asked if people in her community would listen to her, given her age, she believed they would only do so if they knew they would be paid. Interestingly, Ishaani did not believe she had a responsibility, given her age, and the cultural implications of this viewpoint were most clear when she said:

> **Ishaani (Heilala College):** Ko tautolu foki tau kei siʻi tautolu ia. ʻA ia te tau pehē atu tautolu "ʻOua ʻe tutu e vevé he ʻe meʻa e ozone layer ia." ʻE pehē mai ia, "Siʻi, laka koe ki hē mo e fiepoto …" ʻUhinga ʻikai ke ai ha fatoniga ia ʻa kita. Heiʻilo pē ia kapau te te toki ʻalu kita ʻo tō ʻa e tongó, ʻai ʻu meʻa ʻi tahí ʻuhinga ke taʻotaʻofi atu e maumau ko ē ʻu matāfangá.
>
> ***Translation:*** *For us, we are still young. So we would say, "Don't burn the rubbish as the ozone layer will be affected." That person would say, "Get lost and stop trying to be smart …" That's why I don't have any duty [towards the environment]. Unless, you would go plant mangroves, put things at the beach to try to stop the destruction of the beaches.*

Ishaani's response points to the Tongan culture of respecting elders who then direct the activities of others (including youth). Youth in Tongan communities may be understood as being a part of "hierarchical societies with a collective ethos" (Fotu et al., 2011, p. 48). They are furthermore ascribed roles in traditional society based on their age, gender and genealogy. Part of traditional childhood and youth, therefore, requires one to learn to adhere to these ascribed roles as well as the various moral, cultural, and religious values in the ʻapi (*home*), particularly those originating from their mother's side (MacIntyre, 2008). Hence, any attempt to incorporate social action, or youth environmental activism, into the Tongan science

curriculum, must be fully conscious of these local realities and seek ways to become more culturally responsive.

While Ishaani did not think others would listen to her because of her age, she was open to the idea of going to plant mangroves along the shoreline. This, in turn, recalls the narrative and pedagogical activities of her teacher, Tōnunga (in Chapter 5). Ironically, Tōnunga, an adult, was also hesitant to speak out to stop people removing sand, because she was not originally from Haʻapai. Yet, she still sought to give her students authentic coastal planting (i.e. learning) activities that could give young people some responsibility as active citizens to assist their communities to prevent coastal erosion. Throughout the students' talanoa sessions, I found that the idea of replanting mangroves and/or other coastal vegetation was frequently mentioned. For example, Mary Bell stated:

> **Mary Bell (Heilala College):** Ko e fakakaukau ko ē ki he fatongiá, hangē ko e fakatātā ko e haʻu e tahí ko ē ʻo hake mai ko ē ki he fonuá … ʻo hoko ai e ʻauhia ko ē fonuá … ʻoku fiemaʻu ke toe … tō e ʻulu ʻakaú ke lahi pea ʻoua te te toe tata e ʻoneʻoné.
>
> ***Translation:*** *The idea of responsibility, like the example given of the sea level rising up to the land … and causing land erosion … we need to again … replant many trees and not remove the sand.*

As discussed previously, students viewed sand mining and coastal deforestation as destructive practices leading to coastal erosion. Given the urgency of climate change effects and non-climatic drivers of environmental change in Lifuka, it appeared to me that students and teachers desired a culturally and ecologically relevant way to respond to the challenges of climate change and its impact on their immediate environs. This approach, I sense, would require an approach to curriculum design that would contrast with conventional approaches to curriculum design and delivery which is described by O'Steen and Perry (2012): "maintained in a vacuum with little regard to external influences such as current events, demographic changes or even findings from educational research" (p. 171).

What alternative approaches exist that could be relevant culturally and ecologically to the Year 10 science students of Haʻapai and their teachers? To help frame this consideration, I pause to share a passed down narrative from my own family from Haʻapai, which reminds me of the need to consider the context when looking for different approaches to work.

> *My great uncle, Dr Tevita Puloka, was posted to Haʻapai to serve as a medical doctor. People would visit him early in the morning before his official working hours at the hospital in Lifuka. He would ask them to wait at the hospital for the proper clinic hours. On one occasion, his father, originally from Haʻapai, then removed his*

clock from the wall – whilst asking him if the hands of the clock now controlled him. Dr Tevita's father, Puloka, then explained that these people came early to visit Tevita because their travel to Lifuka was dependent on the tides. They came into Lifuka from the scattered islands of Haʻapai on their little boats at high tide. This was the only way they could bring the sick relatives and friends close to the shore, and complete other essential tasks in Lifuka before leaving again on the next high tide.

Effectively, Puloka (my great grandfather) told his son, Tevita, to replace his [mechanical] clinic time to that medium of measuring time based on the community he served. This story above, has been orally passed down the generations in my family to recognise the insight of our elders, given their wisdom and place-based knowledge and the value of serving others while considering this place-based wisdom. It raises the question for me, with schooling, that are we attempting to follow the iron hands of international curricula while ignoring our own ecological and cultural rhythms which may be vastly different from other countries?

Rev. Siosifa Pole (2020) used the concept of Tahi Ua to highlight opportunities that arise with changing times, such as those which arise with changing tides.

> If the low tide happens twice in a day the people of the village see this as a double blessing. It means they can go to the sea a second time and look for more seafood. Two low tides on one day is what we call Tahi Ua, which means, two seas … Because of the importance of Tahi Ua to the survival of our people, I see it as a concept that identifies the inevitable changing of time, the risks, and the opportunities that come with it. (Pole 2020, p. 14)

What (metaphorical) tides are inevitably changing the communities of Haʻapai and their surrounds? What risks and opportunities come with these changes? Firstly, it is clearly obvious that sea levels and coastlines are changing. Research has shown Lifuka has experienced between two meters and 43 m of coastal erosion at various locations on its coast due to climatic and seismic factors (SPC, 2014). The culture of Haʻapai is also changing with increasing participation in commercial practices (Suda, 2013) and the various impacts of the growing transnational relationships forged by the Tongan diaspora (Cave & Koloto, 2015). Social media and mobile technology usage may also be increasingly prevalent in Haʻapai, as Sopu et al. (2016) found that 81% of secondary students they surveyed in Tonga use Facebook.

Changes in Haʻapai also include increased accessibility to local tertiary education with the Tongan-owned Christ's University in the Pacific having recently opened a branch in Haʻapai, alongside the USP. As Pole (2020) proposed, "Just like the concept of Tahi Ua, movement and action are influenced by the context of where they live and by their interaction with the human and natural worlds" (p. 15). There is a need for teachers to respond to these changing tides in Haʻapai, and, indeed, around Tonga, and to consider what alternative

opportunities for environmental learning (through schooling) exist locally in their communities? We cannot deny the changing tides, and we can respond in a way that may help us preserve what is important to our communities.

Are science educators willing to acknowledge that the rich knowledge base we have in Tonga is relevant for learning about the environment, and climate change adaptation? Ladson-Billings (1995) shared an example of a teacher using culturally relevant pedagogy in her practice that resonated with me. She shared how a teacher in the USA working with African-American students would invite relatives of the students in to class to share various skills. However, the teacher ensured that:

> Her guests were parents or relatives of her students … She was deliberate in reinforcing that parents were a knowledgeable and capable resource … [Her students] also learned that what they had and where they came from was of value (p. 161).

I suspect Tonga's schooling system continues to undervalue Tongan people's TEK and their Indigenous sciences (Koloto, 1998). However, I believe it is timely for Tongan science educators to discuss whether the prevalent (anti-dialogical) pedagogies of our science classrooms value our students' cultural identities or ask them to leave their culture at the door as they pursue the prized credentials of science education?

Returning to our talanoa, some students understood that local action requires a resistance of individualistic thinking, shared in response to my question about whether they believed reversing environmental degradation would be possible:

> **Jasmine (Heilala College):** Ko u pehē ʻe lava ʻio ʻe lava ʻo ʻai e foʻi ʻātakai ko eni ko ē e loto fonua ke maʻa kapau ʻe hanga he kakaí ʻo tauhi ia ʻuhingá ʻoua te nau toe fakalaulau ko e ʻapi kehe ē … ʻu ʻapi ko ē ʻoku vaoa mo meá ʻo ngāueʻofa ki ai ʻo fakamaʻa mo meʻá ʻe toe foki pē ʻa Haʻapaí ni ki he fakaʻofoʻofá.
>
> ***Translation:*** *I believe, yes it is possible to make the inland environment clean if the people take care of it, and do not discriminate saying that is another property … the properties which are overgrown and stuff, go voluntarily clean it up and Haʻapai will be beautiful again.*
>
> **Ishaani:** Ko e ʻuhinga ʻoku ou ʻio ai ʻe lava pē ke kole ʻa Haʻapaí ni ki ki he toko taha ko ē ʻoku fakafofonga Fale Aleá ke ʻai mai ē [foreshore]… ko e meʻa ia e kau Haʻapaí ni ke nau tokoni ki hono tauhi ʻa Haʻapaí ni ke maʻa mo fakaʻofoʻofa …ʻUhingá ko e meʻa pē ku ʻikai ai ʻuhingá ko e taimi ko ē ikai ke faaitaha ai ʻa Haʻapaí ni …
>
> ***Translation:*** *The reason I say yes, because the people of Haʻapai can ask our parliamentarian to try to complete the foreshore in Haʻapai … it is Haʻapai's*

> *responsibility to help with keeping Haʻapai clean and beautiful … the reason I say no, is because of the times when Haʻapai people are not united …*

While students value collective action, Thaman (2012) warned that individualism and selfishness is systemically taught through schooling models that originate from far off lands. She wrote, for example, that:

> Pacific cultural values and ideals are often de-valued and discouraged because they tend to conflict with the values that the school is trying to promote. For example, while schooling and the educational bureaucracy rely on notions of universalism and impersonality, Indigenous education systems rely on specific contexts and interpersonal relationships. Schooling promotes individual merit while Indigenous education is rooted on the primacy of the group (Thaman, 2012, p. 5).

The question that arises for me, therefore, remains – how can Tongan secondary schooling be re-imagined to enable the collective local action which the Haʻapai students rightly proposed can stimulate reversal of the environmental degradation they witness every day? My research suggests that the concept of Service Learning (which often occurs under the cloak of PBE initiatives) holds much potential for communities like Haʻapai. That is because, service learning is, "fundamentally about engaging students in the community in order to help meet the needs of that community. Service learning seems to serve as but one example of a responsive, flexible pedagogy that could serve as an initial events-based or responsive curriculum" (O'Steen and Perry, 2012).

I would add that the concept of service learning is already present within the Tongan culture, as part of our nofo-ʻa-kāinga, or communitarian living (Puloka, 2017b), by which Tongan children learn through participation and service of their wider kāinga. For example, during the dramatization of the traditional Tongan lunar calendar, Hina's exhortation to her children (introduced in Chapter 5), stated:

> Tuku e siokita, he ko ho maumauʻangá ia, Tauhi e kāingá, ʻo fai ho fatongiá (Faupula, nd.).
>
> ***Translation:*** *Do not look out only for your own interests as that will be your destruction. Look after the kāinga (relatives) and do your fatongia (obligations).*

Hence, I see little reason why fatongia could not be a key concept in a future Tongan curriculum framework, to drive the future design, delivery, assessment and evaluation of Tongan science Education. The analysis section of this chapter having been completed, the conclusion, which follows, will weave together the main findings of this chapter, which are then related to the following chapter (Chapter 7).

Conclusion

After my talanoa with two groups of students from places around Haʻapai, I have felt that I had gained much from listening to how they made sense of changes around them in the environment. Here in Chapter 6, I have shared their treasured knowledge from our talanoa to enable their voices to be heard and to support the growing call for Pacific educators to "chart their way through their past and present to get the best outcomes for the future development of education in the region" (Puamau, 2005, p. 25). After hearing the students lived experiences, I am still left wondering whether the science educationin the Tongan schooling system is relevant given the changes they face daily – such as rapid coastal erosion in Lifuka.

During our talanoa, the students gave detailed accounts of changes in their local environments. Much of these changes centred around their recovery from TC Ian, which left many local people seeking shelter and long-term solutions to food security. Coastal erosion and sea-level rise were also identified and discussed as intersecting problems by the students, especially when they were focused on describing local actions rather than global causes of sea level rise. These students' descriptions of and learning about local environmental issues in their classes were considerate of both western and Indigenous forms of science. Hence, I recommended that, in future, Tongan education officials might like to consider the merits of adopting an EbA to climate change to better incorporate and validate (Tongan) Indigenous science and TEK.

Next, I explored what students know about their local environments and who they consider trusted sources of local environmental knowledge. As a result, I found the students held strong values regarding the value of inherited family land which, for example, they did not believe should be traded for money. Yet, the transmission of such land-and-sea-based cultural values normally happens in familial/community settings, beyond the school gates. These same traditional values can, however, be deployed to design a future Tongan science curriculum which can resist the negative aspects of globalisation – by simply grounding curricula and teaching in Tongan values, as recommended by the Langa Fale Ako Framework (Johansson-Fua, 2008). Values discussed in our talanoa, which deserve further attention given the cultural changes in Haʻapai, include the concept of fonua (land and people), tukufakaholo (passed down inheritance) and fatongia (obligation). It should be noted that when it comes to environmental issues, most of these values are expressed at the village-level and family-level through collective action.

To that end, I presented an argument for the development of (place-conscious) culturally responsive pedagogies which empower students to serve their communities through positive environmental action that could be developed to meet the needs of Tongan communities like Haʻapai. From our talanoa, I have drawn inspiration for redesigning curriculum and pedagogical practices that may support Tongan youth to take actions for the environment. The next chapter now leads us to metaphorically travel across the Moana to commence the first of two similar cases studies in Port Vila (Vanuatu). As explained previously (see Chapter 3), these Port Vila case studies (Chapters 7 - 8), were conducted to enable me to compare and contrast the experiences of Year 10 science teachers, and their students, in two differing Pacific community contexts.

Chapter 7 : Port Vila teachers talanoa

Introduction

The central research question explored in this chapter is "How do Port Vila teachers frame local environmental issues in their Year 10 science classes?" Ni-Vanuatu educator John Henly (2005) described what efforts to develop a different approach to education have looked like in the Pacific region:

> Some regions and countries have also looked inward for education sector improvement solutions, the Pacific being a good example with its re-thinking education initiatives (Pene 2002; Sanga, Niroa, Matai & Crowl 2004). This home grown discourse on educational development has allowed what Wegner (1998) refers to as "mutual engagement"—the opportunity for dialogue and reflection within a community context, facilitating the emergence of more socially and culturally relevant perspectives on reform. (p. 26)

After completing my first set of case studies talanoa in the island group of Haʻapai, Tonga (Case Study One), I continued my Moana journey, to explore how other Pacific teachers have tried to implement "more socially and culturally relevant perspectives" (Henly, 2005, p. 26) on teaching, particularly regarding instruction about local environmental issues such as sea level rise. On this journey across the Moana, to Vanuatu, I had a clear aim to explore how local environmental problems, whether deforestation, pollution or sea-level rise, were framed by science teachers in basic science, in secondary schools. I was curious as to how my findings in Port Vila, an urban context, would compare with my findings from Haʻapai, a rural context.

The research findings of this chapter, like the two preceding chapters, also suggest the need to shift away from an exam-driven approach to the design, delivery, assessment and evaluation of science educationin Vanuatu secondary schools. This is presented in light of current ecological and cultural realities requiring immediate attention. Similar to teachers in Haʻapai (Chapter 5), the teacher participants central to this chapter share concerns regarding how the constraints of time, and the language of schooling, combine to pose barriers to learning. This, coupled with a perceived gap between the official prescribed curriculum and students' cultural and ecological realities, influenced the Vanuatu teacher participants' framing of local environmental issues.

To address these issues, this chapter is presented in two parts. It is accordingly similar in shape to the structure of the first case study (Haʻapai). The first part of this chapter (Part One) provides contextual information such as where the talanoa took place. It also details how talanoa were adapted and arranged in Port Vila to recognise the cultural differences between

Ha‘apai (Tonga) and Port Vila (Vanuatu). Part Two presents the research findings from my talanoa sessions with teachers in two secondary schools in Port Vila. This discussion is organised into three sections reflecting the recurring themes that arise from my analysis of our talanoa.

Part One: Contextual background

The Republic of Vanuatu is made up of 83 islands and has three main urban centres; Port Vila municipality on the island of Efate, Luganville municipality on the island of Santo and Lanakel municipality on the island of Tanna (Warsal, 2009). According to the mini-census in 2016 (Vanuatu National Statistics Office, 2017), the total population of Vanuatu was 272,459 (p. 1) and Port Vila’s population was numbered at 50,944 (p. 37). Regenvanu (2010) asserted that roughly 80% of Vanuatu’s population live in rural areas and most of these people would speak their Indigenous language and gain their food from the land and sea using traditional methods.

However, people are increasingly moving to the capital, Port Vila, for trade and schooling (Leslie, 2013). This urban migration to the urban centres of Port Vila and Luganville has been happening since the 1960s and 1970s prior to independence. Largely, this rural-urban drift has been underpinned by people’s desire to earn money from tourism, industries and the enlarged civil service (Forsyth, 2009). Vanuatu, formerly known as the New Hebrides, achieved independence on the 30th of July, 1980. Tensions between the British and French colonial powers in Vanuatu left a colonial legacy on schooling and the curriculum design.

Marked linguistic and cultural diversity among the Indigenous peoples of Vanuatu make it starkly different to Tonga. Vanuatu “is home to 138 distinct Oceanic languages … [making] Vanuatu the country with the highest language density in the world, whether compared to its land surface, or its population” (François et al., 2015, p. 1) . Despite this, vernacular languages were not offered as subjects to be studied in the participating secondary schools in Port Vila. As Willans (2016) observed, “since independence Vanuatu has maintained a dual-medium system, so that children are enrolled either in an Anglophone school or a Francophone school, with some parents opting to divide their children across both streams” (p. 2).

Resolving tensions between Anglophone and Francophone systems is reflected, to some extent, by the objectives of the *National Curriculum Statement* (Vanuatu Ministry of Education, 2010b), which focuses on harmonisation of the curriculum, particularly with regard to these colonial legacies of conflict. The cover of the *National Curriculum Statement*, for

example, features a culturally significant sand drawing based on a legend of twin brothers who completed one sand drawing together, each one having drawn a part of it at different times. This following explanation is given at the beginning of the *National Curriculum Statement* alluding to its purpose and the use of this artwork:

> The twins' sand drawing on the cover represents Vanuatu's dual system of Francophone and Anglophone schools that are being harmonised and becoming one system. Just like the twins' sand drawing, the two parts are being drawn together to form one system. The curriculum will be harmonised and will enhance students' and children's knowledge to create thinkers and problem solvers. Just as the drawing was completed by the brothers, creating one education system will assist us to be one Nation, working and living together in harmony (Vanuatu Ministry of Education, 2010, Front matter).

Since 1980, Francophone and Anglophone teachers have been trained in one institution, now known as the Vanuatu Institute of Teacher Education (VITE) which offers a two-year training program for junior secondary teachers as well (Lumelume, 2007) . In Vanuatu, Year 10 students (considered to be junior secondary students) sit national examinations for their various subjects, including their mandatory basic science course. In 2019, 2,224 Anglophone and 657 Francophone Year 10 students sat the Examinations and of these only 1,547 students moved on to Year 11 for 2020 (Vanuatu Ministry of Education and Training, 2020a, p. 18). When considering how local environmental issues are framed in participating teachers' basic science classes (below), teachers' views on the culture of assessment and language of instruction (i.e. English in Anglophone schools) are also closely considered.

Talanoa with Port Vila teachers (Year 10)

Science teachers from two Port Vila schools (state-owned Future College and church-operated Nurture College), participated in this case study (these fictive names were explained earlier in Chapter 3). I entered both schools with the permission of the VCC, after firstly receiving ethical approval from the UC ERHEC. I was able to enter the field to collect data by drawing upon the guidance of my Ni-Vanuatu friends – thus adhering to local (cultural/ethical) protocols.

For example, I was kindly assisted by my friend Naomay Tor to present a kastom mat to each principal along with a handicraft from Tonga, as recommended by the VCC. This gesture helped me to articulate my desire to build mutually beneficial relationships and genuine respect for my fellow Pacific peoples. Specific to Vanuatu, I was made aware of storian, a local method of dialogue described below by Warrick (2009) for research purposes as being "essentially a Vanuatu-specific form of 'Talanoa'" (p. 83). Drawing on material from the

Solomon Islands, PNG and Vanuatu, I also found that toki stori was described by Sanga et al. (2018) as a "communication mode … [which] offers opportunities for researchers and others to follow a relational path in their investigations" (p. 5). Hence, my research methodology in Port Vila was cognizant of the fact that tok stori, alongside talanoa and yarning, could serve as "companion Indigenous conversational forms" (Sanga et al., 2020). However, further research is needed on the synergies between these conversational modes and on the limitations of adapting them in Pacific communities outside of where they originated.

I adapted the use of talanoa in Port Vila with guidance from Ni-Vanuatu friends and officials and by remaining alert to other forms of conversation mentioned above. This allowed me to build rapport with participants during the talanoa, which is at its heart, relational rather than being about exchanging information. As a result, I was able to initiate meaningful dialogue with the Port Vila teachers involved in this study.

I changed my planned data collection process because I found that teachers from both schools preferred to conduct their talanoa with me separately (i.e. at their own campus sites). Sensitive to the time pressures teachers may feel, I instead talked with teachers during their free time at school as they also had other commitments outside of school to attend to. My method of talanoa was also adapted to allow me to get a glimpse of how the participants interacted with other teachers.

At Future College, for example, I held two pre-arranged talanoa sessions with Rebecca and the teachers she invited to join us. In the first session, at Rebecca's request, her colleagues Barbara, and Cathy joined our talanoa. Later, at our second talanoa session, Gina joined us because Barbara and Cathy were not available due to other commitments. Our conversation consequently focused more upon their pedagogical strategies and understanding of the curriculum, with regard to environmental science content. At Nurture College, meanwhile, I participated in one talanoa session with Deborah. She showed me her school's staff room and enabled me to view the teaching resources that supported her classroom practice.

The participating teachers were from various Pacific Islands outside of Vanuatu as well as within Vanuatu. In Future College, Rebecca came from the island of Ambae, located in Vanuatu. Cathy and Gina, meanwhile, were from other Pacific Island countries and had both moved to Vanuatu for family reasons. Barbara hailed from Vanuatu, but she did not identify a specific place within Vanuatu as her place of origin. In Nurture College, Deborah identified herself as an untrained teacher undergoing further education at the USP. Our pre-planned talanoa discussions generally began with introductions and included discussions of science teaching strategies, time management, how the teachers engaged students with the prescribed

content and organised practical activities. These discussions on the broader issues of schooling and the personal experiences of teachers helped provide a context for exploring how teachers may frame local environmental issues.

Part Two: Findings from Port Vila teachers' talanoa

The findings of this chapter are divided into three sections, presented under three thematic subheadings; (i) *The Opportunities of Place and Culture, (ii) The Pressure of Examinations and,* (iii) *Creative Use of Stories Promotes Student Engagement.* These reflect the recurring themes that arose from the multiple talanoa sessions with Port Vila teachers in Future School and Nurture School. The discussion central to this analysis of recurring themes is supported by my analyses of selected curricular documents from Vanuatu.

Using an autoethnographic lens, my own personal experiences of teaching are also drawn upon, alongside international literature to deeply engage with the context of learning and the tensions which exist there. As discussed elsewhere, this deep engagement gave me the opportunity to explore not only Vanuatu's education systems but also Tonga's with a new perspective gained from lived experiences in a place with a different colonial legacy.

The opportunities of place and culture

The Port Vila science teachers I spoke to believed that their students who grew up in the outer islands of Vanuatu possess more local knowledge of the environment. This logic was most evident in the following two extracts taken from my talanoa at both school sites:

> **Deborah (Nurture College):** I would say, students in the islands, oh yes, they know their names well. You know, their local names for the trees and plants and those – but you ask students here, only some. Not most of them, but there's some that might know. Maybe they came from the islands. The outer islands.

> **Rebecca (Future College):** And in Vanuatu, like we have different cultures. It's really hard for us to know everything in all islands! For example, we have some endemic species here in Vanuatu and only some areas. For example, Santo they have those endemic species. Lots of them. Yeah, the birds. But some islands, we are very young! So we don't have those. So we need to use the people from Santo, the students from Santo to explain what they have. Where do they normally find this, birds, for example. Most of the students here, they grew up in towns. So, one way we do it is, I'm going to ask them to go and ask their parents. Ask information on this and this and then come and share it in class … … Cause and their parents will be the one, the generation that grew up in the island.

This finding, in particular, aligned closely with the views of Haʻapai teacher participants outlined earlier in the first case study (Chapter 5). Rebecca, accordingly, made an effort to support the transmission of TEK by encouraging students from "town" to ask their

parents (from the outer islands) about the TEK they possessed. This seems to be a logical way to incorporate TEK. As some researchers elsewhere have argued, this approach "[adds] value to formal education [i.e., schooling] systems in Vanuatu by contextualizing content and process of curricular delivery" (McCarter and Gavin, 2011, p. 1).

As a result, I also observed an interesting implication arising from this rural and urban divide, particularly in relation to the design of climate change education initiatives in Vanuatu. Teachers at both schools mentioned the nation-wide climate zone quiz as a way for students to become engaged with climate change issues:

> **Deborah (Nurture College):** It's a competition where all the schools in Vanuatu … choose some of their best students who, maybe they have a good knowledge on environment, and they came together and they ask questions … It's only about environment and the climate change and the resolutions, what can we do? It's on TV. When they had this competition, it's live on TV.

It would be interesting to evaluate whether TEK is represented in national climate change awareness programs, such as the climate zone guiz.

Various adaptation strategies on climate change in Vanuatu incorporate aspects of TEK. For example, Pedersen Zari et al. (2020) discuss proposed ecosystem-based adaptation projects for the Port Vila area. These include efforts to protect cultural and biological diversity through initiatives such as planting an urban tree library using trees from Efate. From my perspective, projects such as these provide unique opportunities for teachers and students to be involved and to learn how to integrate TEK and 'western' science in their local urban community environs. Although traditional and western knowledge of the environment co-exist in communities, Janif et al. (2016) found that in rural communities in Fiji "there is a tension in the sample villages around the privileging of traditional or western scientific knowledge that increasingly encourages people to choose one or the other" (p. 7). As a teacher, I wondered how Port Vila science teachers also navigated this tension.

Gina, who had migrated to Vanuatu, also recognised that environmental knowledge is situated in a place. Similar to the teachers in the Ha'apai case sttudy, she valued the knowledge of those who are most familiar with this place-conscious knowledge and even contrasted it with the knowledge found in the official 'notes' prepared for her Year 10 science course. She said:

> **Gina (Future College):** To me, like as a foreigner it's – like, if we talk about endemic species, eh – it would be appropriate for someone from that certain area to come and talk about that. That particular endemic species. Rather than me talking about it, in which I have not seen that particular species in my life (chuckles). But, I'm just going according to the description given in the notes, aye? 'Cause, if students get to ask other questions I say, "Sorry, this is just according to the notes".

This approach, recommended by Gina, is reminiscent of the description of cultural understandings Bowers (2005) believed teachers must possess to mediate between different forms of knowledge:

> Like the physician who needs to understand human anatomy and the lawyer who needs to understand the foundations of the law, teachers need to understand the cultural ecology that influences their ideas, values, and every aspect of classroom communication, as well as the cultural ecology of their students. That is, at the core of their professional knowledge should be a deep understanding of culture in all its varied dimensions. (p. 35)

Like their Tongan teacher peers in Ha‘apai (see Chapter Five), the Port Vila teachers who participated in this study emphasised that their students possess prior knowledge about the environment, which their teachers lack.

This finding suggests to me that the role of science teacher education in both countries (Tonga and Vanuatu) may benefit from a reconceptualisation process to equip trainee teachers to learn about the local environment, particularly TEK with diverse Indigenous communities in Vanuatu. This may not be a straightforward task, however, as this knowledge may be restricted by vernacular language proficiency and genealogical requirements. The primary focus of developing Year 10 teachers of basic science in both countries, however, appears to be influenced by the need to prepare learners to sit high-stakes examinations, as explored in the following section.

The pressure of examinations

In junior secondary school, two sets of National Examinations are carried out – in Year 8 and Year 10, respectively (Vanuatu Ministry of Education and Training, 2020c). From my findings, I find that examinations determine teacher and student motivations to engage with science education as well as the pedagogy and the language of instruction of that science education. These findings are explored in more detail below.

Examinations as a motivation to engage with science education. The participating Port Vila teachers mentioned that passing exams was the main form of motivation (i.e., extrinsic) used to engage students, as passing exams offered the reward of reaching the next level of schooling on their way to their chosen career. As Barbara suggested:

> **Barbara (Future College):** That’s what gets [senior science students] motivated because it’s their choice [to take science subjects]. They want the career in life.... Year 10 science, it’s very hard to motivate them. Because it’s a compulsory subject and I think the only thing that gets them motivated is to be able to have good grades and pass on to Year 11. Otherwise, field trips … we think of organising field trips but then, this school has just grown so much and … it will just be too expensive... the

> only motivation Year 10s get is like, we threaten them to (chuckles) do well to pass – so they can go on … and then make up their own choice.

This is significant because Lumelume (2007) found that this heavy focus on exams in Vanuatu maintains teacher-centred teaching pedagogies that would not necessarily be culturally responsive to the learning needs of their students. This was confirmed by the participating students I met in Port Vila (see Chapter 8). They emphasised that exams were a major motivation for them to study, with a particular emphasis from Future College students on passing examinations to maintain a place in their school and reaching their future careers. While my review of the literatures suggests science teachers need more to opportunities to become more familiar with TEK, it is evident that there are significant barriers for teachers in engaging with their students' communities, languages and cultures.

From my talanoa with teachers from both participating schools in Port Vila, I found that they were all under considerable time pressure to prepare students to succeed in examinations and the following excerpts typify these teachers' overall concerns:

> **Deborah (Nurture College):** It's a challenge, I mean, actually with the [work] load that you have on hand and – sometimes I just feel like I just want to make you pass your exam only … (inhales deeply). 'Cause you know when you start and you try to follow all the little things that they have on the prescription? Man, it, you know how it will take a lot and a lot of time. Exams is here and you have limited time. But that comes to my mind sometimes. I want to make you know how to answer those exam questions, that's it! (chuckles)

> **Gina (Future College):** Yes. I have a few [students], who, you know, once you teach them a concept they would be able to grasp it, you know, at the same time. But the rest, it's dragging me. You know? But because this is an exam class … I would not want to slow down for the sake of those, you know, top students.

Perhaps this exam pressure is stronger in Port Vila than in Ha'apai due to the external (national) examination students in Port Vila sit at the end of Year 10 which Ha'apai students do not have an equivalent of in Year 10.

Examinations and the language of instruction. In both case study locations, I encountered teachers who said their students were struggling to answer examination questions due to the fact that they had limited proficiency in the English language. Given that basic science summative assessments are largely written, it is logical that possessing proficiency in the language of assessment is needed to succeed. Teachers in each school, for example, complained that:

> **Gina (Future College):** And one ... of the challenges is the language eh? … many of my Year 10 students their English is not really that good, aye? In their writings, they would write in Bislama … The way they spell words, eh?
>
> **Deborah (Nuture College):** [The students] have that good knowledge about environment. Because we did it in other subjects as well, ah? Social science. In social science they also have some topics about environment where they talk about … environmental issues and solutions … they have that, those ideas in them. But just when, the thing is for them is to write it down and explain. They have this problem writing, you know … But it [knowledge] is there, just how they put it in words and in paper – its ... sometimes you'll, yeah, when you read their work, writing, you can tell that, no they did not know much. But actually they know more, if you just, you know, orally ask them, they will tell you … … in their own words, ah?

During my review of relevant literature, I found that (Robert, 2004) asserted that, in Vanuatu, examinations heavily influence classroom activities. This is true of the language of instruction as well which aligns with the language of assessment. This exclusive use of colonial languages reminds me of Skutnabb-Kangas (2013), who argued that educational systems are destroying linguistic and cultural diversity. While I do agree that English and French only secondary schools are disrupting vernacular language learning, I also believe that teachers in these schools would not be able to significantly change the language of instruction used unless assessments made it feasible for students to be rewarded for learning demonstrated in vernacular languages. This is a complex task given the diversity of vernacular languages found across Vanuatu and within the diverse urban settings of Port Vila (McCarter et al., 2014).

However complex, aligning science educationwith language revitalisation goals in Vanuatu is extremely important, especially given the challenges posed by climate change. Science educationin Vanuatu, according to my participants in Port Vila is currently driven by training students to answer exam questions and primarily uses notes in the English language transmitted from teachers to students to do so. A growing body of evidence suggests TEK holds the potential to simultaneously address language revitalisation goals and enhance students' understanding of their changing environment and the biodiversity around them (Royer, 2016).

This is because the traditional knowledge of Indigenous peoples is encoded in their languages (Maffi, 2005) and language richness can be considered as "the total number of distinct languages found in a given region or country or worldwide, as a measure of linguistic diversity" (Maffi, 2005, p. 603). Vanuatu, therefore, is a country possessing high levels of language richness given that more than100 distinct languages are spoken in Vanuatu (Love et al., 2019). Yet, despite this diversity of languages, one of the subjects in which students learn

more about climate change, basic science, is primarily taught and assessed via two (colonial) languages – English and French at the secondary school level.

This causes me to question what knowledge is left out of schooling, due to the insistence on using colonial languages for instruction and assessment. As Lemke (2001) suggests, we must identify cultural barriers to student engagement and whether the culture of science education is in tension with the culture of students' communities. TEK should, consequently, have a place in the curriculum, especially when evidence suggests that it has an important role to play in building resilient communities. Authors like Regenvanu (2010), for example, have long argued that the ecological knowledge held and practised in rural areas has implications for national food security – a pressing problem in Small Island Developing States (SIDS) given the threats of climate change.

Notably, efforts to ensure the transmission of language and culture in Vanuatu exist outside schooling. These happen among families (as explained by participants later in Chapter 8) and have reported in research regarding the Mewun Kastom Skul in Malekula, Vanuatu. This kastom skul operated from 2012 -2014 and was primarily concerned with combating language shift (Love et al., 2019). I would suggest that research elsewhere, conducted by Gainsford, Gerard and Bailey, 2020 as well as Miller and Roehrig (2018), might indicate that any effort to incorporate and assess TEK in science classes must be co-developed by schools in partnership with those communities who possess that knowledge.

Examinations and pedagogy. Although I strongly affirm the value of TEK, expecting Port Vila science teachers to be knowledgeable about all the different forms that exist in their school communities, this would likely put additional pressure on those teachers who may already be feeling burned out and exhausted, as some participants described. The time demands to prepare lessons which would help students succeed in exams as well as carry out faith related extra-curricular activities also caused Deborah to rethink her career as a teacher:

> **Deborah (Nurture College):** It's not like those other jobs where at the end of the day just, you know, shut down and you're – you know – shutdown your brain too ... but this one, you know, you have to prepare for tomorrow and you have markings … Apart from your teaching load you have extra-curricular activities, so it's a lot of challenge, yeah. But, sometimes, like, to be honest, sometimes I have this thought that, "man I want to quit teaching." A lot of hard work. Really.

However, this concern about time pressure was not limited to Nurture College. Teachers at Future College, the state-run school also expressed the same concern which prompted me to recall Tōnunga's frustrations in Haʻapai (Chapter 5).

In relation to time pressures, some of the participating teachers at Future College were taking an education course at the USP, similar to the course attended by Deborah at Nurture College. These teachers mentioned that constructivism, student-centred and inquiry-based learning were emphasised in their USP course:

> **Cathy (Future College):** So we kind of like, try to move away from the traditional [behaviourist] style [of teaching] ... where you're standing there talking and talking – giving all the information and students writing notes …

> **Barbara (Future College):** But then basic science you can actually motivate students like that, just needs time to sit and plan … and when you get to plan your lessons well and include like student centred activity … students just get motivated to learn science, right?

However, when I asked the teachers if they felt like they have enough time to plan lessons, the answers again pointed to how time pressure is a barrier to incorporating various pedagogies teachers would like to use. Barbara explained how the pace of schooling at Future College leaves her exhausted and, combined with family and community events outside of school time, she finds no time to plan for upcoming classes.

> **Barbara (Future College):** You just rush through. Even lunch is very short and go to next, and then bell rings and the students are gone. So you really have to put through all of them, a lot of things into them, within that short period of time. Yeah, so when it comes time for planning, I just, have no energy at the end of the day … and there's a lot of other things going on as well, like weekend you have a lot of family commitments, extended family, there is a birth, there is a wedding.... there's just, no time.

Meanwhile Cathy and Rebecca stressed that their role as mothers entailed time-demanding family responsibilities which added to the pressures of simultaneously studying and teaching. Cathy best encapsulated this when she said:

> **Cathy (Future College):** With us mothers, we have to plan way into the night, early into the morning... Because, first and foremost, there comes your family. And, then, after that, once your family is settled and that's it. Then that's when it's time for you with your lesson planning. So, sometimes, when we're really tired, next day, we come into class with a very, very poorly planned lesson.

Deborah also shared this experience and emphasised that time constraints limited the way she could teach, while recognizing this was not an ideal situation:

> **Deborah (Nurture College):** Now, we have like 45 minutes for one lesson. And if you want to move students from their classroom to the lab, man you're taking too much time. When you get there and you're just sorting yourself out, the bell goes for the next lesson already … they will tell you. They have less experiments ... sometimes I took this projector down there, I use projector. And use videos ... it's better than

> moving them to that small lab. And its far, moving from here to there, so. I use video most of the times … … I think [the students] are not excited that much. Only because, they, if you do experiments every time, you know, you get their attention. They get to move around, ask questions and you know, do stuff, experiments. But sitting and watching all the time, its not good. They get bored... but video does – when I show the video, yes. They're eager.

In some instances, Deborah even used videos as substitutes for experiments, because of constraints posed by timetabling, facilities, and the large number of students she taught. This finding can be considered alongside research in the *Vanuatu Education Sector Strategy* (Vanuatu Ministry of Education, 2006) which highlighted concerns that teachers are using "blackboard copying and rote learning" (p. 34), thus teaching to the exam rather than teaching relevant life skills. However, the ministry has emphasised its mission is to provide "a quality, student-centred education that is accessible, relevant, sustainable, inclusive, and responsive" (Vanuatu Ministry of Education and Training, 2020c, p. 28).

Despite their ongoing training in learning theories (i.e. to support a shift towards student-centred education), the Port Vila teachers I met still struggled to part with teacher-centred pedagogies. Aside from lesson planning, delivery, and assessment pressures, collaboration amongst teachers is also affected by timetable constraints. Future College teachers, for example, explained to me that one teacher is the course co-ordinator and she assigns different teachers to compile 'notes' for each topic. I understood this administrative approach because the science department I teach in (Tonga), works in a similar way. This approach exists primarily to ensure a standardised curriculum whereby all students are given the same information regardless of the identity of their teacher.

In our second talanoa session at Future College, Rebecca and Gina explained that although teachers are meant to discuss the teaching 'notes', to ensure agreement among themselves (before distributing the notes to students), this does not always happen due to time constraints:

> **Rebecca (Future College):** For each group, it's best for us to give just the same information to the students. And that is where discussion comes in. We have to discuss as teachers. Agree on and then give it out to the students. But then like, in reality there is no time for that, ah? … So what we do here is, somebody just prepares the notes. Somebody else would check, make comments, agrees on then put it on for photocopying to give it out to the students.

After reviewing the transcripts of my talanoa with the Port Vila teacher participants, it became clear these teachers desired to use other pedagogical strategies, which they believed would better engage their students in learning science. However, time pressure demanded that

these teachers focus on exam preparation. This required a narrow set of pedagogical strategies that aligned directly with the (colonial/neocolonial) language requirements of examinations. It did not surprise me, therefore, to find that globally speaking, there are growing concerns that students are disinterested in science. A recurring theme appears to be that teacher and student enjoyment of science education is often hindered by an ideological obsession with measuring "what students know at the expense of how students know" (Osborne, 2010 as cited in Ping et al., 2019, p. 1207).

Cobern (1996), for example, has reported that students tend to compartmentalise knowledge from their science classes and only use it for exam situations. It is therefore debatable whether science classes anywhere can help develop environmental awareness when the knowledge transmitted from teacher to student is primarily driven by extrinsic motivation to successfully regurgitate 'facts' to pass exams (Hadzigeorgiou & Skoumios, 2013).

Research also suggests that EE has been viewed a misfit with traditional schooling around the world, especially in education systems which emphasise the transferral of 'factual' information to students within subject boundaries, rather than developing knowledge about complex issues as is required by EE (Fauville et al., 2014). To some extent, this traditional approach to the design of secondary school science programmes may reflect traditional university teaching. This pedagogy typically tends to transmit decontextualised theoretical knowledge to passive learners in a lecture theatre. Yet, evidence now suggests that many universities (worldwide) are abandoning this anti-dialogical approach in favour of more authentic approaches to learning about real world problems (Herrington & Herrington, 2007).

The editing of this chapter coincided with my return to fulltime work as a secondary school teacher in Tonga. Similar to the experience shared in the research of (Riessman, 2003) on how analysis is also impacted by the life experiences of the researcher, I also felt a deeper connection to the stories shared by the Port Vila teacher in my return to work, particularly in light of the constraints (time etc) teachers face in their regular work days. Equally, I could relate to metaphors found in literature more deeply as well, such as the analogy of McCarthy (1994) of the hīnaki tukutuku (the baited eel trap) which Manning (2009) later adapted to describe teachers who were "feeling [like tuna/eels] trapped by the ideological constraints of the institutional cultures [i.e., hīnaki/eel trap] of their schools" (p. 247).

When reflecting on my own teaching experiences of feeling trapped within the constraints of a mechanical timetable, I was comforted by Tongan scholar Fa'avae's (2018) highlighting of the role of memories as in autoethnography, describing them as "living sources … for meaning making and guidance" (p. 79). By stepping outside my comfort zone to visit

Vanuatu, and after reflecting upon my own teaching experiences in the exam-driven schooling system of Tonga, I can better appreciate the efforts my own colleagues, who have been teaching much longer than me, had made to compromise between how they would like to teach and how they could teach. I could also see more clearly the constraints they (and now I) face, when trying to balance their work commitments with family and cultural obligations while maintaining a sense of well-being.

After reflecting critically upon the findings of my talanoa with Port Vila science teachers, and my own experience/memories of teaching science in Tonga, I offer this poem to acknowledge the time pressure my collegues in Port Vila, Ha'apai and Tongatapu are expected to perform under.

Forgive me colleagues,

When I judged

The ways you tried to breathe.

Their eyes were on you

To dance to their song,

Faster! On repeat …

However, teachers creatively developed pedagogical strategies which enabled them to teach students about the local environment within a highly pressured, exam-driven system.

Creative use of stories promotes student engagement

In Port Vila, all the basic science lessons I observed took place inside a classroom. These lessons were conducted in the medium of the English language. Typically, these lessons commenced with teachers providing handouts, explaining notes and students completing exercises. It was very familiar to the standardised lessons I had taught in Tonga and experienced as a secondary school student. In Nurture College, for example, Deborah's Year 10 basic science class was covering *Topic 10.3 Electricity*, as prescribed by the basic science component of the *Vanuatu Year 10 Teacher's Guide* (Vanuatu Ministry of Education, 1997a).

However, not all teachers adhered strictly to this text-driven pedagogical approach. For example, in my classroom observation notes I recorded how Deborah sought to also incorporate questions which would help students connect the content of the prescribed curriculum notes to their everyday lived experiences. Deborah had two classes consecutively with them that day. In the second class she asked students what they had learned from her lessons earlier that day and one girl mentioned the electric eel. This struck me because I too had noted:

> *Teacher [Deborah] draws an eel on board and writes 600 V next to it. In each cell she writes 0.1. She asks question then students answer and she asks, "How do we get that?" Students shout out answer. "OK last one."* (Classroom Observation Notes, July 5, 2016, Nurture College).

In Future College, meanwhile, I noted that Rebecca was covering the Topic 10.1 *Forces* as prescribed by the *basic science for Vanuatu Year 10 Teacher's Guide* (Vanuatu Ministry of Education, 1997). During my class observation on June 28, 2016, Rebecca got her students to assist each other by working through questions on a handout in pairs. Once each pair of students completed their task, she could choose them to help other students. I asked Rebecca about this strategy in our talanoa session and she explained why she makes this part of her class culture: "I use students in class to teach other … students. When that happens, then the students are eager to finish their work on time so that they can be the ones helping the others".

However, I was particularly interested to learn how these Port Vila teachers were attempting to employ student-centred learning pedagogies (revolving around dialogue), to empower their students to share their lived experiences of the environment. Rebecca made it clear how and why she was seeking to incorporate student voice in the following excerpt.

> **Rebecca (Future College):** Different islands in Vanuatu experience different intensities of earthquakes. So we would go around the classroom asking ... on Santo, Ambae or Port Vila ... Tanna. How do you feel an earthquake or what's the strength of the earthquake on your island? ... And mostly people from Santo will say, it's very strong. And then we'll go back to our diagram of the Pacific – of the Vanuatu Trench ... where it is located ... it's very close to Santo.... So that will be one reason. Yes. Cause in Santo, if there is an earthquake, you can hear it when it's still coming.

This example shows the synergy that can exist when weaving together the benefits of Indigenous storytelling with map readings to teach scientific concepts. This, in turn, has further inspired me to explore how stories of place can be used to contextualise science concepts. Dialogue can be similarly used to enhance students' exploration of the effects and experiences of climate change, thus connecting the prescribed curriculum with students lived realities. Rebecca, again, demonstrated this when she said:

> **Rebecca (Future College):** Like, for example, [think about] climate change … Sea level rising, I would ask them to talk about their areas. If they see any, like any effect of these sea level rising. So some of them came up with some really good ones … So, for example, for the reef, we would state the importance of the reef. It provides food, for example, indirectly to us humans or directly to humans and also it prevents tsunamis for very low-lying islands. So like, the effects, they have seen. So when we talk about that, they're, I think they're probably scared in their minds that if we don't look after the reefs then this is what can happen to us.

This observation, in turn, aligned with the writing of Macedo in Freire (1970/2005) , who proposed that "the fundamental goal of dialogical teaching is to create a process of learning and knowing that invariably involves theorizing about the experiences shared in the dialogue process" (p. 26). In an exam-oriented system, which exerts time pressure on both teachers and students alike to perform, dialogical pedagogies have the potential to greatly assist teachers of science to contextualise the curriculum they are required to teach.

According to Patterson and Williams (2005), "the concept of place (also variously referred to as sense of place, place attachment, and place identity) has emerged as a prominent focus for exploring the relationship between humans and the environment" (p. 361). In Vanuatu, place and kastom are both important aspects of identity (Hess, 2009). This can be seen in the Bislama concept, man ples, which indicates their place of belonging, not usually associated with the city but with one of the islands of Vanuatu (Day & Bamforth, 2020). Mahit (2016) described man ples as, "a person belonging to that particular location; an assertion of Indigenous belonging" (p. vi). For example, someone from Tanna living in Port Vila may identify as "man Tanna" (Lindstrom, 2011, p. 265), although it is questioned whether young people will continue to identify with home islands of their parents in this way (Lindstrom, 2011).

How one would incorporate "traditional" understandings of the environment in Port Vila, however, is less straight forward. As another researcher observed, some second-generation migrants in Port Vila, may "see themselves as no longer rooted in the ground and the social relationships of their original place, a condition of being they refer to as 'floating' (stap flot nomo)" (Kraemer, 2013, pp. 25 - 26) . Interestingly, Niatu (2007) also explains that the word for tourist in her community on the island of Uripiv (near Malekula) in Vanuatu "is dosalsal. This concept literally means someone who floats, is not stationary and has no cultural roots" (p. 52).

When I asked Deborah (Nurture College) if kastom or local/traditional knowledge was part of the *Biosphere* topic, she replied:

> **Deborah (Nurture College):** No. I think it's under social science … If I teach, let's say, *Radioactivity* … And then social science, when it comes to that topic, they just revise what I did already. So we don't teach it twice... taking time.... so they cover that in social science.

The same concern about avoiding repetition of content between basic science and social science classes was raised in the teachers' talanoa in Future College as suggested in the extracts, below:

> **Rebecca (Future College):** There should be a communication between the two departments. So we only teach this part and they teach this part. Otherwise we are just repeating what they have already learned in Social science.
>
> **Gina (Future College):** I'm sure there's a need to review the curriculum … … Cause we have new issues coming in [Rebecca mentioned climate change]. For example, global warming and that, you know? So we shift this to ... social science. And then we bring in these new issues. Otherwise there'll be too much for the kids to learn within a very short time.

The participating teachers from Future College consequently recommended talking to a social science teacher, and/or obtaining their scheme of work, to determine overlaps between basic science and social science when about environmental issues. Topic 10.5 *Biosphere* (Vanuatu Ministry of Education, 1997) covered in Year 10 basic science, for example, contains a section on environmental pressures (pp. 53 - 58) where one of the assessment objectives is to:

> ***B18.*** describe and explain in general terms the effects on natural ecosystems of pressures resulting from the following: industrial development, mining, urbanisation, communications systems, overfishing and poor land management, intensive farming and overpopulation …
>
> ***B20.*** be aware of the possible long-term dangers to man of the following effects from some of the activities in B18: upsetting ecological balances, loss of animal and plant species, impoverishment and erosion of soils, pollution; (p. 53)

These objectives clearly focus on human activities and how these put pressure on the natural environment. From my perspective, it struck me that there seemed to be a focus on avoiding certain practices, which are globally undesirable (i.e., overfishing), without presenting alternative/sustainable lifestyles, grounded in Indigenous Ni-Vanuatu cultures.

The *basic science for Vanuatu Year 10 Teachers' Guide* (Vanuatu Ministry of Education, 1997) also includes what appears to me to be a somewhat western approach to conservation. This is found within the *Biosphere* topic, particularly in the following section concerned with environmental pressures:

> Students should also be aware that wild plants and animals represent a "gene store" that future generations will need to make use of (for example, in the same way in which we have developed crop plants and domesticated animals and obtained medicines in the past). Our present activities are diminishing that reserve. A good homework activity might be a small investigation on extinct animals using books from the school library. (p. 55)

A more culturally responsive pedagogy would adopt a more place-conscious approach which requires Vanuatu students to investigate practices within their communities (in 'town'

or in ‘home islands’) to promote biodiversity and conservation via, for example, the continual planting of certain plants. That or students could explore taboo practices which limit the consumption or hunting of certain endangered animals (as discussed by Hickey, 2006) . What I observed, however, suggests that Vanuatu students are not encouraged to learn about traditional or alternative lifestyles to these practices through basic science.

Hence, I am inclined to agree with Bowers (2002) who advocated for an ‘eco-justice’ approach to the design of science educationactivities, particularly those related to the environment. This approach would help students in Port Vila and Haʻapai alike to “examine the ecological footprint of non-commodified activities, forms of knowledge, and skills acquired through mentoring relationships – as well as learning to participate in these aspects of community life” (Bowers, 2001, p. 13).

While the Port Vila teachers strived to incorporate dialogical pedagogies in an exam driven schooling context, my observations and research findings suggest that holders of TEK must be involved in the curriculum design process in both Vanuatu and Tonga to invigorate the teaching of environmental science. Father Walter Lini, after all, had emphasised that the traditions and cultures of Vanuatu should be preserved through practice and participation at all levels of society, especially when he reasoned that:

> We cannot maintain our traditional and cultural part of our life without actually practising it … And for me to be able to tell the myth and stories in cultural sense to my children, I have to tell them in my language. I cannot move from my own language to tell it in Bislama or in English and I believe this is possible. And because I can do it, I think that other Ni-Vanuatu will also do it if we all believe that it is important to maintain our traditional aspect of life even in 1980 or even in 1990 or even in the year 2000. It is still very important for us. (Father Walter Lini, first Indigenous Prime Minister of Vanuatu, as cited in Vois Blong Manples Tv, 2019, 6:47)

Conclusion

This chapter marked the beginning of my research journey across the Moana from Tonga to Port Vila in Vanuatu. Many of the findings discussed in this chapter have featured themes similar to those I encountered during my analysis of data collected when talking to science teachers in Lifuka, Haʻapai (see Chapter 5). In both Chapters (5 and 7), Tōnunga and Vanuatu science teachers have highlighted that their students possess TEK which is place specific and which they, the teachers (as being from elsewhere) lack. In both case studies, these teachers (Chapters 5 and 7) also sought to encourage students to draw upon their parents’ TEK, rather than to build upon the students’ direct lived experiences in the places they live. With regard to Port Vila, I can see many rich contexts that can shape the future teaching of

environmental science in ways that draw more directly upon the cultures and places of significance to the students themselves.

Due to various time pressures, the Port Vila teacher participants in this study said they have not been able to fully engage with the opportunities their students' lived world contexts might otherwise afford them. Rather, they shared concern that they were required to focus on enabling their Year 10 students to successfully pass examinations conducted exclusively in the medium of the English language. This process inevitably has a detrimental effect on the status and maintenance of TEK and vernacular languages and undermines teacher well-being and job satisfaction. As a teacher, I can also relate to these Port Vila teachers' frustrations and can attest to the daily struggle teachers face attempting to care for their students' futures and their own well-being.

Despite this exam-driven pressure, the Port Vila science teachers I spoke to were still attempting to contextualise the content of the prescribed curriculum by relating key content to the students' lived experiences, albeit in an adhoc manner. This was evident, for example, when I observed teacher participants seeking to stimulate conversations with their students or seeking students' perspectives about lived experiences related to the content being taught. These classroom observations reminded me of Freire's (1970/2005) description of the shift in relationship that can happen between teachers and students whenever dialogue occurs to generate ongoing curiosity about the topic/concept concerned.

With this focus on student voice fresh in mind, the next chapter (Chapter 8) focuses on stories shared by students during our talanoa. These stories detailed their experiences of the intersections that did/did not exist between their experiences of climate change, schooling and life in Port Vila.

Chapter 8 : Port Vila Students' Talanoa

Introduction

Fasi (2005) drew attention to the importance of reconsidering the role of summative assessment activities within schooling, developed in the pursuit of a 'quality education':

> Students' achievements need to be considered within the context in which learning takes place, in order to provide a fuller picture and make more sense of the multitude of factors that influence the quality of education … Questions that [education] planners may need to address include: What does quality education mean? What do we need to do to improve the quality of education? (pp. 100 – 101)

The purpose of this chapter, therefore, is to present Port Vila students' conceptualisations of local environmental issues alongside their learning experiences in school and other community contexts. After exploring Year 10 science students' conceptualisations of local environmental issues in Ha'apai, my ancestral island group in Tonga (see chapters 5 and 6), I desired to learn how these were conceptualised by Year 10 student in another Pacific country experiencing similar environmental changes.

By using a talanoa approach (see Chapter 3), I met with Year 10 students from two different schools in Port Vila, Nurture College and Future College (pseudonyms). Through a series of talanoa in Port Vila, I was able to hear stories of students' lived experiences of schooling and environmental change – resulting from climatic and non-climatic factors. For the sake of consistency and manageability, this chapter is similar in structure to the preceding three chapters (chapters 5 to 7). First, it commences with a description of the research context and then the talanoa process is presented (Part One). Next, a discussion of research findings is provided (Part Two). These findings are analysed to hopefully contribute to a discussion about what "quality education means" (Fasi, 2005, p. 101) considering these students' concerns and lived experiences in the environments that have shaped the formative years of their lives.

Part One: Research context in relation to the talanoa process

Context

The Republic of Vanuatu consists of 83 islands (Tarosa, 2013), divided into six provinces (as explained in Chapter 4). While most of Vanuatu's population live in rural areas, Shefa province (where Port Vila is located), is the most populous with a population of 97,602 (Vanuatu National Statistics Office, 2017). Vanuatu's economy was best described as "'highly dualistic', with a modern urban economy in Port Vila and Luganville and a subsistence economy in the rest of the archipelago" (Sardos et al., 2016, p. 723).

Vanuatu was also ranked first out of 178 countries on the 2006 *Happy Planet Index* which ranked countries based on *Life Satisfaction*, *Life Expectancy* and *Ecological Footprint* (Marks et al., 2006). Regenvanu (2010) asserted that in Vanuatu, as well as neighbouring Solomon Islands and PNG, the "traditional economy – still outweighs the cash economy in terms of providing livelihoods for the population" (p. 30). According to the 2016 mini census carried out after TC Pam, the percentage of households engaged in production of selected vegetables for rural areas was 97.1% and in urban areas was 61.6% (Vanuatu National Statistics Office, 2017, p. 2). These selected vegetables included kumala (kumara), yams, Island cabbage, cassava as well as bananas and pawpaw.

After gaining independence from British and French joint colonial rule (as described in Chapter 4), the tourism industry grew rapidly in Vanuatu (Tabani, 2017). Tourism contributed to 64.8 % of Vanuatu's Gross Domestic Product in 2014 (World Travel and Tourism Council, 2014 as cited in Dornan & Cain, 2015). However, ecological concerns also arose from the growth of this industry. Vanuatu's endangered marine mammal, the dugong is also threatened by excessive contact with tourists and development of areas previously noted as 'hotspots' (Lawrence, 2019). Two popular dive sites for tourists in the island of Santo – the SS President Coolidge shipwreck and the "undersea junkyard" (Klint et al., 2012, p. 93) at Million Dollar Point – are reminders of the united States of America's presence in Vanuatu during World War II (WWII) (Klint et al., 2012). These sunken WWII vessels are also sources of marine pollution as they continue to corrode underwater (Monfils, 2005).

Tourism, however, also brought about the commodification of kastom because traditional ceremonies were now performed for the purpose of "raising revenue instead of maintaining social relations" (Tabani, 2017, p. 244). According to Richard Shing (2006), oral culture was the main way that information was passed on traditionally in Vanuatu and information passed on like this has even aided archaeological research. Chief Roimata's burial site, for example, is a place where, according to oral tradition, men and women were "buried alive in shallow graves" (p. 200). The exact position of this burial site was preserved through the accuracy of oral traditions.

These traditions were problematic for Christian missionaries, who Shing (2006) reports had attempted to "eradicate part of the Indigenous cultures and customs" they believed to be demonic (p. 202). This cultural clash draws attention to the role of VCC, whose field workers attempt to archive kastom knowledge (Shing, 2006). The VCC also promotes local, traditional food in island communities through, for example, the *Slow Food Festival* to resist the

colonisation of traditional diets. This stance argues that certain diets "are integral to local cultural and ecological sustainability in many cases" (Flexner et al., 2019, p. 135).

According to the *WorldRiskReport* 2020, Vanuatu was ranked No 1 in the world for being most at risk of natural disasters due to high exposure to earthquakes, storms, floods, droughts and sea level rise (Kirch et al., 2020). In the aftermath of Category 5 TC Pam, which struck Vanuatu (including the island of Efate) in March 2015, vegetation and gardens were destroyed and soil quality compromised. This devastation was further complicated by the El Niño drought (McEvoy et al., 2017). Yet, Day and Bamforth (2020) argued that there was a rural bias in the distribution of humanitarian aid, neglecting the peri-urban settlements of rural-urban migrants just outside of Port Vila, in Blacksands and Manples.

Churches in Vanuatu were also part of relief efforts, forming the "interdenominational Church Working Group" (p. 3) helping to co-ordinate between churches and government (Banfield, 2017). More discussion of the effects of TC Pam has already been provided in chapter 2 Literature Review. Given the magnitude of this event, I wanted to explore how Port Vila students navigated challenges during and after TC Pam as well as other impacts of climate change they have witnessed in Vanuatu, such as sea level rise (McEvoy, 2017).

Port Vila continues to attract young people and families from the other islands of Vanuatu who may be seeking work (Lindstrom, 2011; Stern, 2017). Kraemer (2013) described the feeling of disconnection experienced by some Port Vila youth to their "parents' home island" (p. 3), as they had limited knowledge of the language and kastom of that island community. In Port Vila, Bislama is commonly used to communicate between people who do not have the same vernacular language (Vandeputte-Tavo, 2013). However, English and French are the official languages of schooling at secondary level (Vanuatu Ministry of Education, 2010b). The talanoa therefore considers these contextual factors when exploring how local environmental issues are conceptualised by students.

Talanoa with Year 10 science students (Port Vila)

I visited two Anglophone schools in Port Vila, located on the island of Efate (see Figure 8.1). In 2016, these schools were selected in co-ordination with the provincial Shefa Education Office. More details of the process which enabled me to enter these Vanuatu case study sites have been provided earlier in Chapter 3 (Methodology). As was the case in Ha'apai (Tonga), I once again sought to invite science teachers and Year 10 students to openly discuss local environmental and schooling issues via a series of talanoa.

All the participating students (three from each school) were selected by their basic science teachers who also participated in this Port Vila case study (see Chapter Seven). All talanoa sessions were conducted during school hours, and at the students' respective school campuses (i.e., church-operated Nurture College and at state-operated Future College). Unlike the talanoa in Ha'apai, all Port Vila talanoa sessions were conducted in the English language.

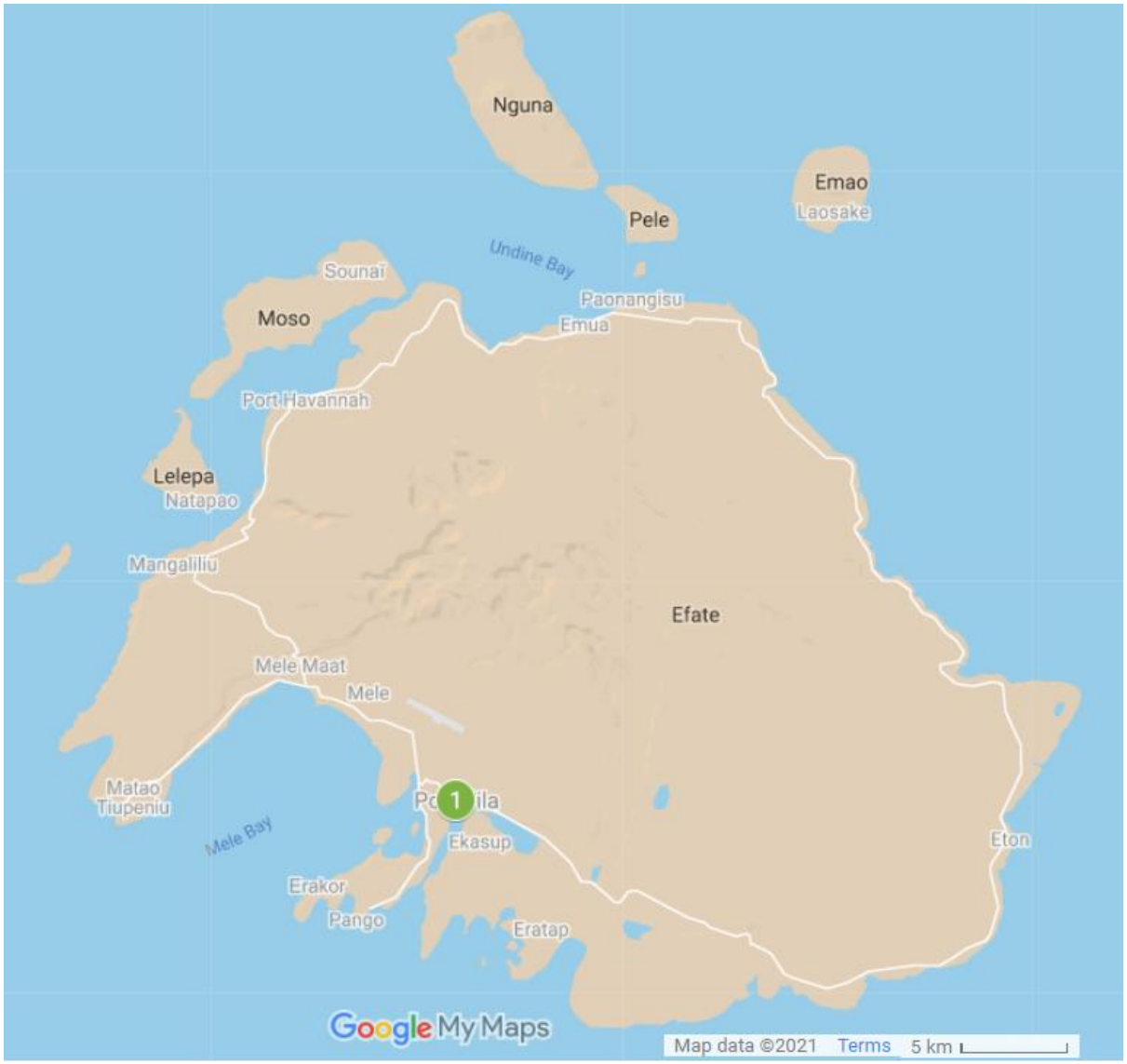

Figure 8.1: *The island of Efate and neighbouring islands, located in Shefa Province in Vanuatu. Port Vila is indicated by a green marker labelled with number 1. The Metropolitan Port Vila Region (see McEvoy, 2017) includes the communities of Pango, Eratap, Erakor and Mele. Map adapted from Google Maps (n.d.-d).*

As mentioned in Chapter 3, I had planned to have two group talanoa sessions with students at each school. The first and second talanoa sessions with students at Nurture College were held at lunch time on their school campus. I also had an unplanned talanoa with the two

female participants on their campus, while I was waiting to meet with a staff member. This unplanned talanoa proved quite helpful in terms of providing clarification about the details of schooling in Vanuatu. In Future College, the first talanoa session with students took place on their school campus during lunch time. Since Future College was conducting extra-curricular activities during my visit, the students requested we meet during one of these activities. This subsequently provided me with an extended talanoa session.

As with the student participants in Ha‘apai (see Chapter 6), I have used pseudonyms to protect the identities of participating Port Vila students, who largely self-identified as being from islands beyond the shores of Efate, where they live and attend school. To protect participants from being easily identified, I have concealed the exact place names of the other Pacific countries some participants identified as their places of origin. I deemed this to be necessary given the small size of these communities within Vanuatu. All of the islands identified by the student participants are, therefore, part of the Vanuatu archipelago (see Figure 8.2) unless mentioned otherwise.

In each talanoa group, there was one male participant and two female participants. In Future College, our talanoa group consisted of one male student (Casillas from the island of Santo) and two female students (Cattleya from the island of Santo, and Bella who claimed heritage from the island of Tanna and another Pacific Island country). In Nurture College, our talanoa group also consisted of one male student (George from the Vanuatu island of Paama) and two female students (Francis from the greater Port Vila area and Anastasia from another Pacific Island country).

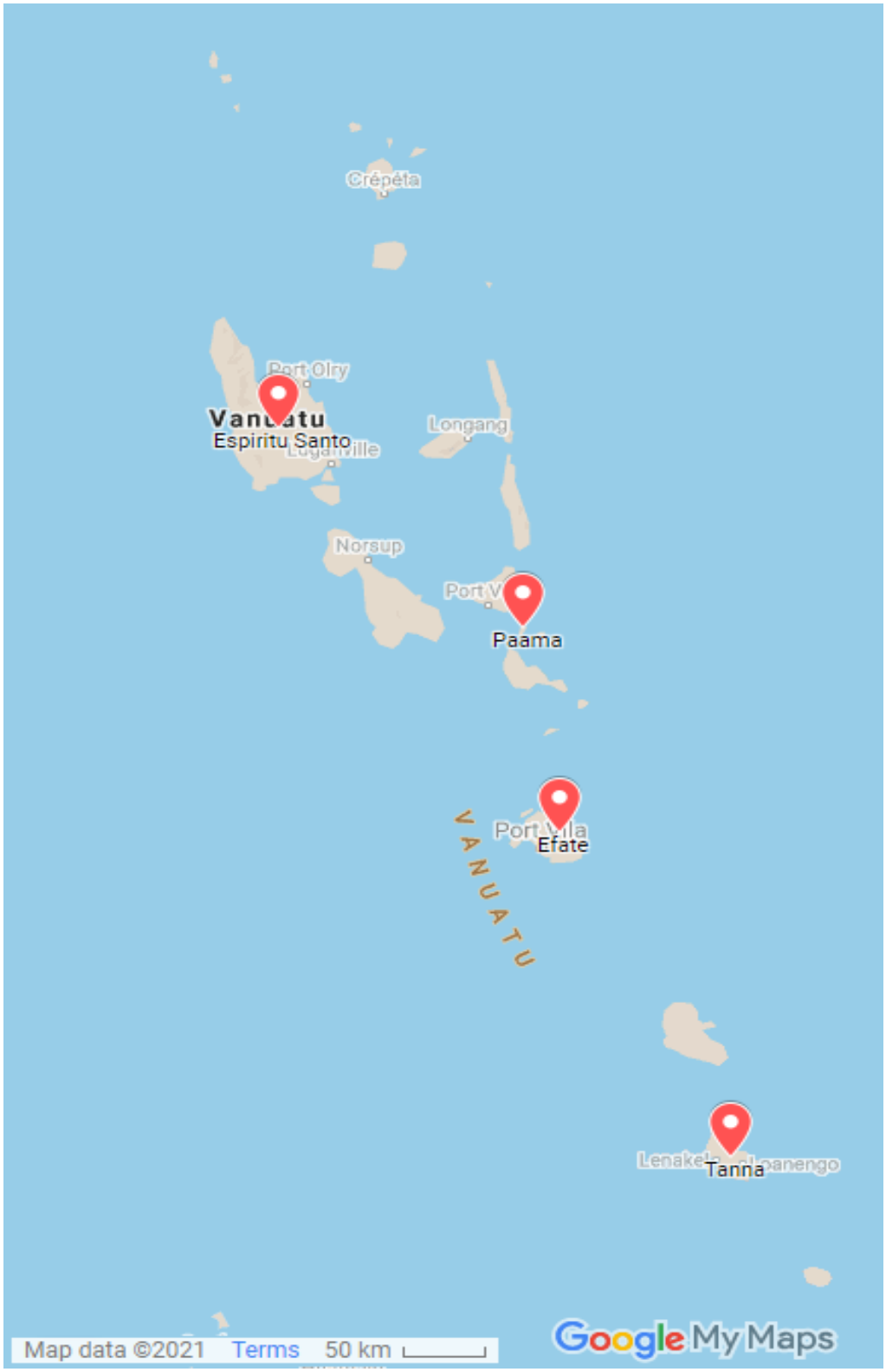

Figure 8.2: *A map of selected islands of Vanuatu, with a red marker indicating islands where participants self-identified as being from. This map was adapted from Google Maps (n.d.-a).*

I began our talanoa sessions in a similar manner to those in Ha‘apai (see Chapter 6), by exchanging introductions and asking students to describe their favourite place in the country.

However, each of the Port Vila student talanoa sessions had their own unique dynamic and they moved in differing directions. While Nurture College student Francis mentioned TC Pam early on in our talanoa, with regard to changes observed in local environments, Future College students did not raise their experiences of TC Pam until I prompted them later in our second talanoa. Here, I found myself needing to respond to the students' replies (to my TC Pam prompt question), by adding follow-up questions based on the students' answers as an animated conversation unfolded.

Since it was my first time in Vanuatu, our talanoa sessions also included discussions regarding the provinces of Vanuatu, with consideration of linguistic and cultural diversity plus aspects of schooling in Vanuatu that were unfamiliar to me (i.e., the national examinations process). As a result, I noted some differences between student responses in the talanoa group sessions at the two Port Vila school sites. Most notably, I recorded extensive discussions about career aspirations at Future College, whereas Nurture College student participants were more focused on learning about environmental issues in their social science class. Possible reasons for this variation are discussed later in Part Two of this chapter.

Part Two: Findings from Port Vila students' talanoa

The findings of the talanoa sessions that took place with Future College and Nurture College schools were thematically analysed. The findings are now presented below, along with supporting evidence from relevant assessments and curricular documents, also obtained from these schools. Similar to Chapter 6 (Case Study One: Ha'apai Students' Talanoa), findings are organised under emerging themes. These include (i) *Vanuatu's changing environment and culture* (ii) *the Permeable Classroom in the Pacific* (iii) *a Case for Placed-Based Education in Vanuatu.*

Vanuatu's changing environment and culture

In this section, I present various ways participants linked the environment and culture. The dugong and turtle were identified by the student participants as the two species which were generating preservation attempts in Vanuatu. Students described dugongs as being "small in number" due to hunters. However, Francis (Nurture College) reported there was one in her village. She said, "Yeah we have one they're keeping it at my village. They, every day, they go and feed it. And when tourists go, they take them to go and see the dugong."

While students did not mention conserving dugong habitat specifically, studies have highlighted the importance of conserving the seagrass habitats of dugongs to ensure adequate food supply for breeding (united Nations' Environment Programme [UNEP], 2002). In Port

Vila, seagrass was reported to be smothered from both sediment from construction (i.e. of the wharf) in Ifira and sand moved during recent cyclones (SPC, 2017). This is important to remember as students in Future College later described coastal reclamation and wharf construction projects they were aware of.

Future College students, however, also mentioned that more conservation areas now exist in Vanuatu to protect endemic species. They advised, for example, that turtles were also captured by locals. Two Future College students also pointed to changes in culture as a cause of turtle population decline:

> **Bella (Future College):** Some islands' tradition – they use [turtle] ... they kill it for meat. Like to have … the traditional food ... and then they use the shell, like, as souvenirs.
>
> **Casillas (Future College):** Yeah, cause in the past, like, they just use turtles, like, only for a reason ah? Like if they are having a ceremony, then they kill turtles. But, nowadays ... ... they just eat whenever they saw turtle, they just kill the turtle.

These students went on to explain that the Government had "put a taboo" on turtles, which meant that people would have to pay a fine for killing one. In our talanoa, the turtles and dugongs embodied the tension between different views on local interactions with them, whether for conservation, consumption, ceremony or even as a means of attracting tourists. In some areas in Vanuatu, kastom prohibited people's consumption of turtles, while those people were involved in yam production, an example of traditional resource management (Hickey, 2006). Traditional (i.e. local Indigenous peoples') ecological knowledge (TEK) systems were considered valuable by students in Nurture College.

Elsewhere in the Pacific, I found literature addressing Christian beliefs in Fiji that reportedly led to debate over whether the devastating Category 5 Cyclone Winston was caused by divine forces rather than a manifestation of climate change (Cox et al., 2018). Although Port Vila students did not discuss the causes of Cyclone Pam, they shared their experiences of it and focused on what people could learn from that situation. All of these participating students survived Category 5 TC Pam, and the subsequent drought, which attracted global attention in 2015 (the year before our talanoa took place). The students identified Cyclone Pam as a force of environmental change in Vanuatu directly impacting their communities, as one student suggested: "After the cyclone, when we were driving around, you could see all the damaged houses and the roofs blown off ... Oh some of the people ... their houses flew away. They came and stayed at Nurture College" (Anastasia: Nurture College).

With these comments fresh in my mind, I was more alert to the debate over usage of the term “Climate refugees” being used to describe Pacific Island residents impacted by climate change (McNamara & Gibson, 2009). Yet, when explaining why Nurture College took longer than other schools to restart after the cyclone, I noted that George used the term “refugees” to describe those who had sought shelter in classrooms. Although I had not expected it, the students highlighted the impact of TC Pam on the vegetation they were used to seeing in their communities and they attributed the subsequent drought to El Niño:

> **George (Nurture College):** I live up in the bush and on a hill so when I woke up in the morning to look out, like all the places there's no more leaves. Leafless. Just, yes, it looks like a desert, you can see ... See straight ...
>
> **Bella (Future College):** You come out of your house and like, "OK did I just land in a different planet?” Cause it’s not the environment that I used to live around." ... you see trees bent and you see brown, brown, brown ... Cause right after that El Niño season ... the trees you can't see them with a green leaf.

In response to my question about any environmental issues in Vanuatu before or after Cyclone Pam, students in Nurture College also highlighted the El Niño event as presented here:

> **George (Nurture College):** El Niño. After the cyclone ... the place was dried, dried up. No water. No rainfall ...
>
> **Francis (Nurture College):** There was no water ... in the [outer] islands, they have to travel far places to get water.

Ironically, after being inundated with water from heavy rainfall and storm surges from the sea during TC Pam, they experienced an unforgettable lack in water. Hence, I focused on presenting the students’ stories to vividly capture their experiences of the water shortage that followed destructive TC Pam. The fact that El Niño was mentioned by students in both schools particularly caught my attention since this is a naturally occurring variation in the Pacific region’s climate, due to the El Niño Southern Oscillation (Collins et al., 2010). During an El Niño event, east to west trade winds weaken resulting in a warming of ocean temperatures in the Central and Eastern Pacific which can lead to cyclones and droughts as well as produce other impacts (UN OCHA, 2014). Interestingly, Ha‘apai students in our talanoa also highlighted the drought that followed TC Ian.

The Year 10 Port Vila students, I met, however, told me that they did not learn about El Niño in classes, but rather from their parents and the media. This highlights the need for greater flexibility in the curricula in order for students to be able to learn about events relevant to their community, such as natural disasters. When I asked students in Future College what

they would want to include in a new basic science syllabus they suggested lessons learned from TC Pam. Here are two examples that best encapsulate their comments:

> **Cattleya (Future College):** So, I think what they should write in the book [the new syllabus for Year 10 science] is, actually state how many death there were during the Pam. And actually ... signify the fact that it is really important for everyone to stay inside the house and listen for instructions from the Meteo – cause it's, you know, it's a must!

> **Casillas (Future College):** I might advise them not to ignore the warnings that are given out. Cause during Cyclone Pam, most of the people ignores the warnings so ... like she said, cause in the past like, they usually said that a tsunami is coming so people move up to high ground then it doesn't come so, the next time it happens again so people move until this time, so they're tired of moving, so they think it's not gonna happen.

I also found these students seemed to believe that science education should have an impact on students' interactions with their environment. Sea-level rise was, for example, another phenomenon students were well aware of in areas around Vanuatu. Bella, for example, had noticed the sea level rising in Mele village, where she goes to swim with her cousins. In our talanoa she also mentioned that in Mele, "they're removing sand to like sell, for people to use to build houses and stuff." George, similarly, mentioned the sandy beach was disappearing at Kawenu. However, the students did not think the current efforts to mitigate sea-level rise were sustainable. They described large-scale projects to "bury the sea" with soil taken from other areas, which they believed did more harm. Cattleya and Bella best typified this thinking when they said:

> **Cattleya (Future College):** ... in my mum's village in Malekula... they came over to bury the sea cause its coming up and so ... its reducing the amount of land in that area. So they need land for planting. So they have to come and bury the sea, so ... it's OK but then you're destroying the marine life ...

> **Bella (Future College):** Birds, forests, they use those places for like, to hide and stuff but when they cut down trees to like remove soil, it's pretty much destroying an ecosystem.

Although they realised the negative impacts of these efforts, the students highlighted the complexity of decisions their government must make about how best to adapt to sea-level rise, especially given the growing population. Cattyleya (Future College) asked**: "**Like what shall we do ... there's people born every day? And they need to bury the sea in order for us to provide land for the generations to come." While relocating communities at risk was proposed, Cattelya reminded us that a previous relocation in Torba province proved a difficult task as people were moved away from their plantations and established services.

Nurture College students also believed in conservation and promoting environmental awareness. Hence, the following talanoa responses recommended social actions:

> **Anastasia (Nurture College):** I think it's very important to learn about the environment 'cause we could either be harming the environment or helping the environment. So we should learn how to help the environment instead of harming it. But .... you know, stopping pollution and stuff like that ... You know in big countries they do oil spills and stuff like that. You know just to prevent those stuff from happening helps the environment a lot. And we could advise the, the population, to put their rubbish properly and stuff like that and stop burning. Like little things help the environment.

> **Francis (Nurture College):** I would go to schools and make some awareness to help them to teach about how to stop harming the environment.

Nurture College students held these environmental concerns alongside their Christian beliefs. In one case, I asked students how they would 'solve' a mystery in the environment such as fish poisoning in certain areas. George responded that he would, "Ask God. Because He is the Creator, and He knows everything." Later, I asked the students, "Do you think it's possible to reverse the pollution, reverse the sea-level rise and that?" They answered no and I asked a follow-up question to clarify if they thought these changes to the environment were "God's will". Students particularly wrestled with this question, as is shown in the excerpts from our talanoa session presented, below:

> **Anastasia (Nurture College):** Yes. It's just signs of the final days … Jesus [will] come back to save us so, take us to heaven, yay! …

> **George (Nurture College):** No. I don't think so. Because He made this world perfect and then it's only us who didn't do right …

> **Anastasia (Nurture College):** Like George said, God made the world perfect and we just, you know, I mean Theories of Evolution and Industrial Revolutions [breathes in sharply], so ... we don't know if it's God's plan or not cause we don't know everything about God, and we don't know if He's planning this stuff or if it's just our faults.

A theological evaluation of the various beliefs regarding the promised return of Jesus Christ in the Christian scriptures, or suggested responses to this, is beyond the scope of this thesis. It was, however, notable to me that Granderson (2017a) found that "the End of Times" prophesy where Christ's coming will be heralded by a series of disasters, was also regularly referenced by clergy" (p. 7) in her research regarding climate change in the islands of Tongoa and Mota Lava in Vanuatu.

As a teacher-researcher, I sought to affirm the value of considering diverse narratives, including those based on spiritual traditions such as those found in Pacific Christianity. I did

this in order to contribute to "making human sense of climate change" (Hulme, 2008, p. 6, as cited in Fair, 2018, p. 2). Hence, it was significant to discover that elsewhere in Vanuatu, Fair (2018) for example, had found that in the aftermath of TC Pam in Vanuatu, "the story of Noah was repeatedly invoked as a parable for the need for greater preparedness" (p. 9).

Why should religious and cultural beliefs be of concern to science educators, and particularly to those of us who are concerned with ecological crises faced by local and global communities? I feel it is a matter of being culturally responsive teachers. As Cobern (1991) has argued, science concepts are more meaningful when teaching in a way that links with students "everyday experience" (p. 5). Furthermore, Laugksch (2000) proposed that "the isolation of science from the wider culture may result in the general public failing to understand science properly, and as a consequence citizens respond to science with a mixture of adulation and fear" (p. 85). Elsewhere, Rutjens et al. (2021) have reviewed research on the "(social) psychology of Science skepticism" (p. 276) in relation to climate change, evolution, skepticism and vaccine hesitancy to predict Covid-19 vaccine hesitancy. Notably, they cited studies (Rutjens & van der Lee, 2020; Rutjens et al., 2021), which found that "self-identifying as a religious and particularly as a spiritual believer has been found to be a more potent contributor to skepticism in various other domains" (Rutjens et al., 2021, p. 277).

Bowers (2002) also proposed that "Patriarchy and anthropocentrism are root metaphors that can be traced back to the biblical account of creation" (p. 22). This echoes an earlier concern of Lynn White Jr, who in 1967, pointed to Christian beliefs as being the cause of our global ecological crises (see Moo, 2006). It was consequently of real interest to me to encounter research conducted in Haʻapai by Bender (2002) which reported that:

> According to the environmental model of many Tongan fishermen, God is held as creator of and provider for both fishermen and fish. He also legitimises exploitation of the fish which are conceived of as reproducing without limits, as incalculable and as mobile. (p. 60)

It is of interest to me how ecological implications of faith are represented in research and this causes me to wonder how to help students navigate these issues at the interface of science and religion.

In Haʻapai, Havea (2020) similarly reported a participating teacher whose views of climate change had been significantly shaped by her family's Christian faith: "Lavinia's perspectives about climate change were heavily influenced by her religious beliefs and by what she was advised by the elders that their religious beliefs in God can always save them from obstacles" (Havea 2020, p. 256). My findings in Port Vila, however, present students who are

carefully considering their Christian beliefs, and not regarding their beliefs as a hindrance to environmental action (I draw this conclusion based on Nurture students' answers to my questions about the environment elsewhere).

What is the role of a basic science teacher in Port Vila, particularly in terms of navigating the spaces that sometimes exist between Indigenous cultural and conflicting religious and scientific beliefs about climate change? Drawing upon my experiences as a Tongan researcher, teacher and Christian, I believe that to help cultivate a safe place where diverse students can learn science, teachers must enable students to cross cultural borders and explore issues from a range of perspectives. As Aikenhead (1996) has proposed, "teachers [can] play the role of "tour guide" taking students across the [cultural] border and directing their use of science in the context of the students' everyday world" (p. 24).

This social constructivist stance recognises that "the prior or Indigenous knowledge of the learner is of significance in accomplishing the construction of meaning in a new situation" (Jegede & Aikenhead, 1999, p. 45). This notion of the science teacher being a tour guide resonates with me because it would provide a safe place for students to learn, and for them to become familiar with 'how' to navigate conversations and even information about controversial topics. Another pedagogical approach that allows students to explore the (changing) beliefs, stories and environs of a place is PBE (discussed later in this chaper), which also requires a permeable notion of the classroom.

The permeable classroom in the Moana

This research was not concerned with documenting an exhaustive list of local environmental issues students witnessed, but rather it has attempted to explore their beliefs about those issues and the ways in which schooling influence them. According to Khalifa et al. (2019), one indicator of a colonising school system is "the inferiorizing and subsequent dislodging of the educative process from elders and oral community traditions" (p. 586). On the other hand, a decolonising approach to schooling, "promotes the co-construction of knowledge with students, teachers and communities", thus integrating Indigenous knowledge systems (Bishop, 2003; Kepa & Manu'atu, 2008 as cited in Khalifa et al., 2019, p. 590).

I consequently wondered, how Port Vila students might interact with TEK as a knowledge system amid other knowledge systems embedded in schooling or in the wider Vanuatu. The student participants discussed the tensions they felt existed between three knowledge systems. These were: (i) Christianity, (ii) kastom and, (iii) school science. The students gave examples of some core beliefs of each of these three knowledge systems. They

also identified the tensions they saw existing between these sometimes competing epistemologies. As Casillas (Future College) mentioned in the previous section, a change in people's consumption of turtles was associated with a disregard of earlier customs.

In our talanoa at Future College, students jointly defined kastom stories as their "ancestors' beliefs before Christianity came" to Vanuatu. This pattern aligns with a suggestion made by Bolton (1999) that kastom was a term that originated out of Christian missionary efforts to make a distinction between what they considered acceptable and unacceptable behaviour. According to Bolton (1999), kastom is held in opposition with the term skul which referred to, "the whole missionary project of education" (p. 341).

In our talanoa, Future students contrasted kastom with what they learn at school. Bella gave this example (below) of a kastom story regarding the origin of a volcano in Tanna, which contradicted what she had also learnt about that volcano in science class:

> **Bella (Future College):** So which one do I believe, my grandpa or science class? ... And then my grandpa is like 'OK you follow me and then I'll show you proof.' So I follow him and then he shows me [grandpa connects kastom story to place when they visit the volcano] ... And I'm, like, 'Wow! OK. Now I believe you"… It's like, pretty much I believe grandpa! (chuckles)

Her Indigenous place-based educational experience (facilitated by her grandpa) seems to stand in sharp contrast to how the teachers (in Chapter 7) described their science classes which mainly take place in classrooms, away from the ecosystems they are learning about. As observed by McCarter and Gavin (2011), "TEK transmission is usually experience-based, learner-centred, and acquired through social interactions such as play, in contrast to knowledge transmission in the formal school system (23 - 25)" (p. 11).

Nurture College students also discussed the value of ancestral knowledge of the environment. I had asked the students who they thought had the most knowledge of the environment in Vanuatu. When their answers focused on staff of Government Departments, I asked them about the knowledge of people in the outer islands whom they referred to as "locals". Then they shared the following views:

> **Anastasia (Nurture College):** I think locals are the ones that look after the environment more. 'Cos they know they have to treat the environment and have to take care of it … Different medicines that can be used from plants and stuff like that.

> **George (Nurture College):** The locals are the best ones [to talk to about the environment]. Because ... it's from one generation to another, they pass it down from the ancestors. I think they are best.

Despite going to school in Port Vila, George was still well-aware of the TEK practice from the island of Paama associated with the preparation of thatch houses before a cyclone. The high value he placed upon this traditional knowledge recalls, for me, the findings of Granderson (2017a), when he was working among Kurumambe and Purau villagers in the island of Tongoa, an island North of Efate (Vanuatu). Here, Granderson (2017a) found villagers who:

> … perceived high adaptive capacity within their household and the wider village … identified a range of traditional strategies that have been, or could be, implemented to manage changing climatic risks. Self-reliance was a trait that these villagers valued and were proud of. They noted that their ancestors have thrived in the face of a range of climatic and geological hazards on Tongoa Island (p. 551).

In an extended talanoa at Future College, I presented a hypothetical scenario to students. It asked them what would they teach if they had to go to a village and teach a topic from their science class? In their responses, Cattleya and Casillas best described more of the tensions the group of students believed existed between the different belief systems of Vanuatu:

> **Cattleya (Future College):** Well hmmm, it's quite difficult, 'cause you know how we learn about things, like for instance, evolution. And the evolution theory. If you go back to the old people and we try preach them something, they'd be like – [says together with Bella] "No!" … It's their belief. 'Cos you know they stand strong on their beliefs, so they won't believe what we believe …

> **Casillas (Future College):** Yeah, 'cos in science we learn that ... life begin from the primeval soup.... then it evolves into complex organisms and moves to land and become apes and monkeys and it evolves into humans. In my village, we believe that we come from different clans of animals ... so we believe that we come from flying fox. Others believe that they come from rats ... Then we compare to the church, Christian belief, we believe God created us. So, now we are confused, we don't know which one is correct! And, if we are Christian then we just believe that God created us.

Cattleya and Bella also readily identified that their clans came from sharks and black and white snakes respectively. This scenario has since prompted me to recall the words of Father Walter Lini, the first Prime Minister of Vanuatu after Independence from colonial rule:

> And to us maturity, as far as Vanuatu is concerned, means knowing your tradition and knowing your culture, knowing what you believe in, in the Christian religion, and principles in Christian religion and choosing what you want in the modern life and in the future. (Vois Blong Manples Tv, 2019, 5:01)

As a researcher and teacher of science I wonder if the 'maturity' Father Walter Lini envisioned requires teachers to step beyond preparation for exams and into meaningful engagement with communities' to better understand their experiences of cultural and

environmental change in relation to their religious and cultural beliefs? Reverting to an autoethnographical approach, here I will now recall my own experiences of the tensions I experience in my own pursuit of science Education. I will do this (below) by using a Tongan method called talaloto (Fa'avae, 2018; Naufahu, 2018).

According to Naufahu (2018), talaloto is "a personal testimony of the lived reality experiences of an individual" (p. 15). Fa'avae (2018) acknowledges the common use of talaloto in religious contexts in Tongan communities. However, Naufahu (2018) also points to its origins prior to the arrival of the missionaries where composers "told his or her story through the lyrics of songs" (p. 18). I present this account (below) of my own personal experience as a young student (crossing the Moana from Tonga to Aotearoa New Zealand) in the pursuit of higher education. Later, in this thesis, I will revisit it again, to reconsider how teachers of science, may navigate through diverse beliefs in the classroom:

> *I recall my own experience of learning about evolutionary ecology in the secular University I studied at in Aotearoa New Zealand. My lab partner could not believe I was a Christian, who believed the Bible (as she checked), which says things like, "By faith we understand that the universe was formed at God's command, so that what is seen was not made out of what was visible." (Hebrews 11:3, NIV Bible, 1978/2011). We had great conversations, possibly intrigued by each other's different reasons for enrolling in the same course.*
>
> *While it may not be everyone's experience, learning about the diversity in nature (including the cells of my own body), resulted in me being amazed at God's handiwork and wanting to learn more and wanting to protect this bio-diversity. Perhaps one helpful factor was that my lecturer did not discourage me from reflection on Christian beliefs about origins in our assessments but allowed me to reflect on my own beliefs alongside what I was learning about evolutionary ecology. As a secondary school Biology teacher in Tonga, I am on a journey of learning how to support my students to do the same, not expecting them to leave their identities at the door to learn something "for the exam". That, in my experience, can be painful and confusing.*

The *Vanuatu National Curriculum Statement* (Vanuatu Ministry of Education, 2010) emphasises the value of custom and culture as well as the value of learning from and about religion. However, it highlights the constitutional duty of parents to help their children in understanding culture and customs. The curriculum's role is then described as:

> Our curriculum supports parents in this important duty. The cultural and spiritual component is an important aspect of all Ni-Vanuatu children's and students' lives and the curriculum should support parents in their role as custodians of their cultural and spiritual practices. (Vanuatu Ministry of Education, 2010, p. 43)

While teacher and parent relationships would be important to ensure this, Tambe (2004) found through interviewing Port Vila primary school teachers that "teachers spoke of a common perception held by teachers that roles are primarily in, not outside the classroom … When this view is firmly held, teachers are not likely to take the initiative in establishing links with parents" (p. 275). Connell (2006) also reported a view of a parent in Vanuatu who believed that "parents should not blame the schools for a lack of cultural knowledge as parents have some responsibility to teach life skills to their children" (p. 23)

Indeed, students who shared more stories of kastom knowledge in our talanoa sessions (Casillas and Bella) linked this to their grandparents and place-based learning experiences. In Future College, I had asked students if they also learned about traditional knowledge (i.e. from their grandparents) or knowledge from church in their basic science class. Casillas' answer (below) seemed to underline the distinction he makes between traditional knowledge and school knowledge.

> **Casillas (Nurture College):** According to family, my grandparents? Like cause in the past there's only, like, people only go to school until they reach Year 6 and they stop. Now my parents – my grandparents – they don't really talk about education to me, 'cause my stage now, I already pass their stage of knowledge in class so they don't talk about education. But what they talk about is our culture. That, like you're saying, this tree is good for – like if you cut yourself and when you want to close the wound, you need to use that leaf or stuffs like that.... But they don't really talk about education in schools.

The distinction between 'education' or school and community knowledge seems to be recognised by students and researchers. In Vanuatu the transmission of TEK is primarily transmitted from parent to child based on cultural practice (McCarter, 2012). For example, in a peri-urban community in Port Vila, learning kastom associated with feasts in the community was expected to be taught by parents to children from a young age (Wentworth, 2016). In Tonga, children may learn how to gather shellfish (a practice called fangota) from their mothers as they accompany them to the lagoon (Malm, 2009).

Further afield, in native communities in Alaska, traditional caribou hunting practices, where the hunter and hunted shared a closer relationship, could be learned through hunting with fathers (Barnhardt & Oscar Kawagley, 2005). Although families play an active role in transmitting cultural knowledge in Indigenous communities, schooling requires that children spend a significant amount of time away from home, even more so in secondary school in Vanuatu when many students board away from their traditional communities of learning

(McCarter & Gavin, 2011). How then could secondary schools support students' growth in understanding of cultures and customs in Vanuatu (Vanuatu Ministry of Education, 2010)?

From our talanoa with students, I identified two recurring challenges of schooling discussed by students, which may be considered as barriers to TEK transmission within schooling. These challenges involve the competitive nature of schooling and instruction in a colonial language. According to Maffi and Woodley (2010), "the belief in the interconnectedness of humans and nature has been widespread in the worldviews of many Indigenous and traditional societies" (p. xix). Therefore, biological diversity is linked with cultural and linguistic diversity, summed up in a term, "biocultural diversity" (p. xix).

In a similar vein, Rapport and Maffi (2011) argue that the loss of languages and cultures are caused by the same drivers of biological diversity loss and propose an eco-culture health perspective. For example, one factor indicating eco-culture health would be vitality described as "the capacity of the system to sustain itself (transmit/reproduce) so that its potential for life in both nature and culture is undiminished" (Rapport & Maffi, 2010 as cited in Rapport & Maffi, 2011, p. 1044). This is significant when one considers how Skutnabb-Kangas (2013) makes efforts to draw attention to the ways in which Indigenous languages hold valuable knowledge about how to protect biodiversity. She rightly asserts that "teaching (only or mainly) through the medium of English is undermining the world's linguistic diversity, and thus also its biodiversity" (p. 90).

As outlined in Chapter 2, the languages of schooling in Vanuatu are reflective of the colonial rule of Britain and France in Vanuatu, particularly in the 1900s. However, Future College students told me students were expected to speak English at school and even Bislama was banned on their campus. Two Future College students below even shared that they are not confident in their Indigenous languages of their places of origin:

> **Casillas (Future College):** I'm Santo, but I understand my mother tongue, but I cannot like – they speak to me, I can understand it but, to respond to them in [mother tongue] language I can't, so I just speak with them in Bislama …

> **Bella (Future College):** I speak Bislama, English. I understand my mum's language [from another Pacific country]. But dad [from Tanna], they speak to me, I understand it but I can't respond back ...

While students cannot speak in their vernacular languages, they identify a powerful resource for language learning in their family members, who can speak the vernacular languages of their ancestors. This caused me to wonder, whether families could play a more prominent role within the schooling system, and share their knowledge, linguistic and cultural,

which teachers could not realistically learn given the restrictions on their time? Perhaps the key lies in breaking down barriers between schools and their surrounding communities, so curriculum is negotiated.

As Thaman (2009) has suggested, schooling in many Pacific Island Nations "continues to be Eurocentric in its value underpinning, content, pedagogies and assessment of students, causing many learners to be pushed out of school and some parents to refuse to send their children to school" (p. 2). How can we then understand examinations and assessment in light of our historical Moana context? If education is "worthwhile learning" (Thaman, 1992a; Thaman, 2002 as cited in Tari, 2004. p. 95) then quality education in Vanuatu should also provide students with skills for living well in communities in Vanuatu as well as internationally (Tari, 2004).

Although Future College students discussed schooling as a means of securing a career in the future, they also mentioned the unemployment of school educated people in Vanuatu (see Chapter 7). Given this shared observation, it seems timely to vigorously question the widespread assumption that 'good' schooling outcomes automatically lead to careers within Vanuatu or overseas. While students seemed confident that they would further their studies after secondary school, they shared doubts about career prospects in Vanuatu. They seemed to believe that migrating overseas was the logical choice for pursuing jobs as typified in the following extracts:

> **Casillas (Future College):** Well, if only I had a scholarship. And, I'd travel to one of the other countries. Maybe after graduation, I'll just live there.

> **Cattleya (Future College):** ... so you know like how people go [aspire] for [a job as] pilot, they come back, but there's not much opportunities or jobs provided? ... And, yeah, overseas you get more – opportunities.

These participating students also believed that unemployment and/or limited jobs in Vanuatu were linked to issues associated with youth drug abuse and violence. While I am not suggesting that it is wrong to migrate outside of one's country to pursue a career or further education, I do question whether schools also provide students with skills to live sustainably within their local communities. In certain parts of our talanoa sessions, the Port Vila student participants also framed schooling success narrowly in terms of passing exams, which they saw as their gateways to a career. This inevitably led to competitive learning and the ranking of both learners and schools based on exam results as shown by the two examples below:

Cattleya (Future College): There's a high standard of competition. And, so, we all have to try and pass all our exams in order to come back here and basically all of our parents want us to come back here. So, we work hard for it.

Anastasia (Nurture College): You sit for the exam and then at the end of the year they read out your names and then cause every school has their own ... standards. So when you take the exams, they put you in – what standards you can thing so ... Like in Year 11 they'll either put you in [top three schools] or go to other schools ... ... most of the kids wanna go to [top school] 'cos they do scholarships …

It was also significant that Nurture College students had expressed concern to me that Future College was ranked higher than them. In 1990, Vanuatu became a member of the South Pacific Board for Educational Achievement (SPBEA), which was set up in 1980 – partly to localise New Zealand examinations – such as the *New Zealand School Certificate* and the *New Zealand University Entrance* exams (Bray, 1998). Similar to Tonga, Vanuatu used to take part in the sixth form regional examination administered by the SPBEA. This examination was nationalised by the Vanuatu Government in 2014 and Vanuatu now has its own *Vanuatu National Qualifications Framework* (Tarosa et al., 2016).

Regional boards, such as the SPBEA, were set up to pool resources and technical expertise. Also, to minimise dependence (Bray, 1998). While this may be the case, we must, however, consider whether this spread of "formal education" (Soaladaob, 2010, p. 31), facilitated by the SPBEA, has undermined the value of "informal education" that was already taking place in the Pacific (Soaladaob, 2010, p. 31). We must furthermore, consider how this has been impacted by Vanuatu's determination to re-think its education system (Sanga et al., 2004).

Due to the perception that 'top schools' or 'high quality' schools are located in Port Vila, schooling has the impact of influencing internal migration patterns in Vanuatu. This can in turn result in youth being removed from TEK sites of learning, which are place specific. Bella best demonstrated this in her story, shared earlier. Here, she had described her grandfather taking her to the volcano in Tanna to explain the associated kastom story of its origins. Hence, it seems reasonable to assume that the phenomenon of removing young people away from their communities for the sake schooling, to some extent, disconnects them from their familial/community holders of TEK, kastom knowledge and (ancestral) vernacular languages.

The Nurture College students' comments about the public ranking of their school, based on exam results, reminded me of schooling in Tonga, where exam results are also announced on the radio. As a result, certain mission schools (who accept anyone regardless of prior exam results), are publicly stigmatized due to their lowly rankings. As a young teacher, I well recall

being invited by another teacher (Mrs. ‘Alieta Langilangi) to a class dinner party with her students and their families. At this party, each student’s strengths (despite their lowly assessment grades) were celebrated and prayed for. The memory of this party has stayed with me over the years since it was so different to my behaviourist practice of only ‘rewarding’ those students who mastered assessments.

What effect did this hierarchical/competitive view of schooling have on Nurture College students studying science? One student, Casillas, alluded to how the exam-oriented nature of schooling can impact student engagement with the science curriculum. Casillas wished to become a structural engineer in the future, and he explained that:

> **Casillas (Future College):** To me, most of the science class, I just ignore them ... So, I just need to understand them, pass them for my exams just to move on ... So, only some of the classes I feel like I'm interested to know ... Some others, I just come to understand to pass my exams. Cause if I hate them and I don't come to class, well if I fail my exam then I can't go on.

It is interesting that he shared the same focus on examinations which seemed to be putting pressure on teachers (as described in Chapter 7).

Having outlined the need for a permeable classroom based on my interactions with Year 10 students in Port Vila, I will now address those findings that suggested an alternative approach to schooling which would require a more place-conscious technique to the teaching of science.

A case for placed-based education in Vanuatu

When theorising his rationale for a critical pedagogy of place, Gruenewald (2003a) argued that:

> In place of actual experience with the phenomenal world, educators are handed, and largely accept, the mandates of a standardized, “placeless” curriculum and settle for the abstractions and simulations of classroom learning. Though it is true that much significant and beneficial learning can happen here, what is most striking about the classroom as a learning technology is how much it limits, devalues, and distorts local geographical experience. Place-based education challenges all educators to think about how the exploration of places can become part of how curriculum is organised and conceived. It further challenges educators to consider that if education everywhere does not explicitly promote the well-being of places, then what is education for (Orr, 1992)? (Gruenewald, 2003a, p. 8)

This argument reminds me of the quote by Fasi (2005), shared earlier in the introduction of this chapter, which similarly asked what does quality education mean? In relation to the aims of this research, should we expect quality science education to have some sort of impact on the

local environment schools are located in? The Year 10 Port Vila students I spoke to shared a belief that schooling holds the potential to shape people's environmental behaviour.

When I asked students at Nurture College what they would do as teachers to make the *Biosphere* topic more interesting, Francis and Anastasia expressed ideas that resonated with the critical pedagogy of place model – proposed by Gruenewald (2003a):

> **Francis (Nurture College):** I would take them on field trips .... take them to different places where they can see the difference from how people harm the environment, yeah and how they can save it …

> **Anastasia (Nurture College):** We could do, you know just encourage them to ... would they want their grandchildrens to come into the world and not know about, like turtles .... So, just keep encouraging them. And take them on a lot of field trips!

I similarly asked students at Future College how they would teach someone else about the environment, and Cattleya responded by "being a model through positive actions". The students in Future College also expressed eagerness to incorporate lessons about TC Pam, such as heeding warnings given on the radio. Our talanoa also captured the role of families and 'place' in education that also helped me recall the critical work of Gruenwald (2003a). In places where no scientific baseline data exists on sea level in specific areas, local observations are particularly important to assess sea-level rise or other impacts of climate change (Granderson, 2017b).

Spending time in family contexts also gave students opportunities to learn from their experiences of their elders who could share observations over a longer period of time, in a certain place. Casillas, typified this when he said:

> **Casillas (Future College):** For me, my grandparents – they usually talk about climate change. Yeah, 'cause, when we go back to our village, they used to take us to the sea, the beach and show us. "At our time the sea level just finished here. But now it's already up there!" Yeah, cause it's very sad to see that. Most of the places that ... they used to have fun. It's all covered with water!

Although field trips are strongly recommended in the syllabus, none were able to be taken in any Year 10 basic science classes prior to (or during) the time of my research trip. This is not to say they did not happen later that year, but to acknowledge that during my talanoa sessions with teachers in Port Vila (see Chapter 7), they explained they had little time to organise such trips. Moreover, the number of students in Year 10 made it logistically difficult to plan a field trip. Basic science, as the Port Vila science students described it, did not take them (the students) outside the school compound.

When discussing the relationships between sustainable education and Indigenous peoples during my talanoa with Port Vila students, I later found it interesting to note that Gregory Cajete (a Tewa Indian academic: USA) had also concluded that:

> In these understandings and relationships, the aim must be to maintain cultural diversity, protect human health, create sustainable economic relationships, reconcile social issues non-violently, and most essentially protect the environmental life support system (Cajete, 2020, pp. 2 - 3).

Throughout our talanoa, the Port Vila students recalled vivid learning experiences of the environment, which involved learning in a place and linking science to that place with a traditional story or narrative of place. In many respects, this reminded me, also, of Basso's work alongside Western Apache – noting that 'wisdom sits in places' (Basso, 1996, p. 134). This place conscious/land based approach involved many instances contextualised experiential learning that stood in contrast to their basic science classes. What they experienced in basic science was constrained by the physical limitations of the classrooms, which removed them from their communities and natural world.

These learning experiences involved 'affective' (multi-sensory) learning experiences, like those recommended by Manning and Harrison (2018). Such experiences stood in stark contrast to those of their basic science classes – where they learned about decontextualised scientific concepts – disconnected from concepts and contexts (i.e. places) of significance to them. Their comments reminded me, again, of the concerns of Gruenewald (2003a) about the place-less curriculum. Yet, places in Vanuatu are strongly linked with stories that the students I met had remembered and associated with a place. For example, Future College students mentioned Chief Roimata's domain in our first talanoa session in response to my question about places they felt connected to:

> **Cattleya (Future College):** So that's the in Vanuatu, so in Heart Island, there was this old guy, he's, he's a chief. He's called Roimata … So he was one of the chiefs and back then there was cannibalism, people eat each other. So he was one of the biggest chiefs until he died. And the history part was like he had – a hundred and something wives.
>
> **Bella (Future College):** And when he died …
>
> **Cattleya and Bella (Future College):** … All his wives…
>
> **Bella (Future College):** … were buried with him …
>
> **Students**: Alive!

> **Cattleya (Future College):** So, it's more like a taboo area and one of the heritage located areas in the world. Yeah ... Like, out of bounds, people are not allowed to live there. You're not allowed to live there. 'Cause it's used ... Like I said, it was one of the world heritage areas ... So they use it mainly to keep history, you know? Make history alive. So, we are not allowed to go live there, cause... you know how people go and tend to live in other people's land without permission is what happens mostly ... not a lot, but, around here. So they're trying to keep it out so that I dunno... they just wanna retain that ... ... you know, atmosphere of history in that island.

Students told of WWII place sites (SS Coolidge and Million Dollar Point) in Santo as also being storied. A common theme in Cattleya's description was that history is preserved by keeping people out of a site or limiting their actions within that place but Place-Based Education (PBE) presents a different approach. PBE "can be defined as any educational approach that uses the local environment as the context for teaching and learning" (Russell-Ciardi, 2006, p. 71). It only seems reasonable to contend that science teachers can become more creative, by co-designing PBE initiatives in their local communities, or even within the school campus.

However, a barrier to the incorporation of TEK held by local communities may be constructivist pedagogies. Bowers (2002), critiqued constructivist theories and pedagogies for undervaluing traditional knowledge and argued that "learning about the traditions of the different cultural groups would be a waste of time for teachers who hold to the idea that students construct their own knowledge and values" (Bowers, 2005, p. 33).

Bowers' (2005) critique is significant when we consider it in relation to the observation of Hickey (2006), who suggests that TEK is central to sustainable management practices of communities in Vanuatu:

> Much of the marine related traditional knowledge held by fishers in Vanuatu relates to increasing catches while managing resources of cultural, social and subsistence value. Traditional beliefs and practices associated with fisheries and their management follow natural cycles of resource abundance, accessibility, and respect for customary rules enshrined in oral traditions. (p. 11)

When reviewing literature about the experiences of Indigenous (Native American) communities in North America, I found writers like Cajete and Pueblo (2010) have argued that those who design and deliver the schooling curriculum, provided to Indigenous learners, must recognise that TEK has already been transmitted for generations within those learners families and communities. They reasoned, therefore, that another approach is needed to build upon the prior knowledge of Indigenous peoples in North America which allows Indigenous students to

“explore and express their collective heritage in education and to make the kinds of contributions to global education that stem from such deep ecological orientations" (p. 1132).

Given the concerns of writers like Bowers (2005), Hickey (2006), Cajete and Pueblo (2010) I will now explore the status of TEK in the teaching of Year 10 science in Tongan and Vanuatu seconday schools. In Malekula, another area of Vanuatu, it was also timely to note that McCarter and Gavin (2011) had identified ethical considerations to evaluate before one attempted to incorporate TEK within the Vanuatu schooling system. They cautioned that while there is a growing need to recognise that TEK is associated with family knowledge, it may not, accordingly, be appropriate to share that knowledge outside that familial group (McCarter & Gavin 2011). Since much of the TEK is passed-on from parent to child through “vertical ... knowledge transmission” (p. 11), McCarter and Gavin (2011) cautioned that any effort to change the mode of transmission could affect the nature of that TEK.

Another problem identified by McCarter and Gavin (2011) includes the need for a curriculum that is “flexible enough to incorporate local views and empower TEK holders, despite emanating from a central government” (p. 11). McCarter and Gavin (2011) further claimed the values of TEK may be contradicted, and invalidated, by those prevailing pedagogies and values traditionally found in schooling. Here, they suggested that schooling will likely decontextualise and erode traditional modes/pedagogies of TEK transmission – especially if that information is now to be transmitted via a textbook, in a classroom removed from traditional sites of learning (McCarter & Gavin 2011). Hence, there are opportunities to adapt a model of place-concious learning in Vanuatu that is cognisant of the complexities and the value of incorporating TEK into science education.

After considering the views of teachers and students in Haʻapai and Port Vila, particularly with regard to my own experiences of teaching, I could well relate to Fitzgerald’s (2018) feeling of being:

> ... disenchanted with the public school system and the ways in which I was expected to teach Science ... I realized that over time I had been experiencing a slow disconnection to people and places and my natural environment ... At that time I felt constrained by the Western framework with Science teaching in our public-school system. I was not able to afford my students the kind of experiential learning that would help them better connect with where they lived and become aware of the issues in our local environments (pp. 2-3).

From these talanoa, I became aware of how schooling can afford students experiences of connection or disconnection from their environments and culture as well as the collaboration

and dialogue required between teachers, students and communities to re-think alternative ways of carrying out science education in the Pacific that address our environmental challenges.

Conclusion

This chapter began with the question, "what does quality education mean?" (Fasi, 2005, p.101). This question was considered while exploring the primary research question, "how do [Port Vila] students conceptualise local environmental issues?" It seemed that the Year 10 students I met in Port Vila believed their schooling, while exam-oriented, should have a positive impact on the environment. They highlighted their concerns regarding changes they had witnessed in Vanuatu's environment such as threatened native species, sea-level rise and TC and El Niño induced changes. Students also shared concerns about changes in beliefs and culture, particularly regarding how they juggle interactions with TEK, Christianity and school science content. The privileging of colonial languages over vernacular languages also came to light as a serious matter in their schooling, as well as the competitive nature of schooling which compares and ranks different schools and students alike.

Given the cultural and linguistic diversity in Vanuatu, and the cultural role of parents in transmitting kastom knowledge to their children, it only seems logical that more attention be paid by science teachers to revitalizing the connections between families and schools – to break down any ideological barriers that may sit between schools and communities. One alternative approach to exam-oriented classroom-bound learning was also presented in this chapter (PBE). PBE, in essence, focuses more upon learning in the environment alongside community TEK holders to undertake culturally appropriate social actions.

Having concluded this chapter, the next chapter (9), will synthesise the implications of the various talanoa held in Ha'apai and Port Vila.

Chapter 9 : Synthesis and implications of case studies

Introduction

This chapter consists of three parts. The first (Part One) identifies and critiques the four recurring themes identified throughout my various talanoa across both case studies, with students and teachers in Haʻapai and Port Vila. In Part Two of this chapter (9), I will draw attention to the unique contextual issues and complexities I encountered in each case study location. Here, I will emphasise the biological and cultural diversity of the Pacific region. Part Three of this chapter concludes by offering reflections on future research journeys that might be undertaken to enhance the development of science educationin Haʻapai, Port Vila and other communities of the Pacific region.

This chapter closes with some personal reflections regarding what I, personally, have learned from the research participants on my journey. I offer these learnings with humility, to Tongan and Vanuatu educational leaders and traditional knowledge holders to inspire further talanoa, toks tori, storian and/or other forms of "dialogical engagement" (Sanga et al., 2020, p. 1).

Part One: Recurring themes

Theme One: Connectedness to place

Throughout the emerging themes explored in talanoa with Haʻapai and Port Vila students and their science teachers, it was evident that all the participants recognised a strong connection between local people and places of significance to them. During each talanoa, participants of differing ages, in both locations, shared multiple sources of knowledge about their natural environment, including Indigenous TEK and western scientific knowledge. From the students' stories in both locations, I learned that the environment was not seen only as a place to go for sustenance. They did, however, discuss the importance of having access to freshwater sources, especially when considering the effects that TC Ian had on local agriculture.

Beyond this, the environment was also viewed by participants as a source of meaning-making and serving as an identity marker. The Tongan concept of fonua, for example, provides an alternative to industrial/western cultural conceptions of the environment. Fonua, to reiterate what I have explained elsewhere in this thesis (see Chapters 4 to 6), can be understood as the land or a country, whilst simultaneously meaning the placenta upon which a baby relies for nourishment in the womb (Churchward 1959, as cited in Fehoko 2014). This definition hints at a deeper meaning of the concept of fonua, often understood by Tongans as comprising

various “interdependent relationships” (Taufe‘ulungaki, 2004, p. 3 as cited in Tu‘itahi, 2005, p.19). Tu‘itahi (2005) built on this description clarifying that these relationships were “among peoples, and between people and the environment”, and when these relationships were maintained at a community or national level, this was referred to as “tauhi fonua” (p 19).

Perhaps the most well-known use of the fonua concept (that best demonstrates its socio-political, spiritual and ecological implications in Tonga), revolves around the historic Tukufonua ki Langi event in 1839 (T. Havea, 2020) . This is when King Tupou I yielded his fonua (land and people) to his Christian God for protection rather than transfer that responsibility to the military might of a colonial power (Niumeitolu, 2007). Fonua, therefore, is a multidimensional concept, one extending beyond the material world, which cannot be measured. Instead, it transcends western cognitive/physical constructs of nature. The spiritual dimension of the fonua comes into play in efforts to maintain a harmonious relationship with nature and people individually and collectively. Now, with the adoption of Christianity, the traditional concept of fonua incorporates God as the Creator (Tu‘itahi 2009 as cited in Fehoko, 2014) .

Tongan scholar Samate (2007) described how a uniquely Tongan way of thinking about authority and relationships could inspire Tongan-based curriculum development. Describing the work of her colleague Rev. Dr Mele‘ana Puloka, she asserted that “Tongan logic starts with who not with what (or reasons why)” (p. 49). The motto of Tonga states that “God and Tonga are my Inheritance”. In the Tongan understanding of this motto,

> the “inheritance” (tofi‘a) that King Tupou I dedicated to God refers to all the lands, people, the sea and everything in it … God has a responsibility to us and so do we to God, to each other and to the environment (Samate, 2007, p. 56).

I believe that future research on science education considering the intersection of the spiritual and ecological implications of the fonua concept in contemporary Tonga, or similar cultural concepts in Vanuatu, may be very valuable in re-imagining curriculum development inspired by Indigenous concepts. Considering some of the deeper epistemological/spiritual dimensions of fonua, I would encourage Tongan science educators to consider how we can best respond to the spiritual or religious beliefs of Tongan students to help them better understand their local environmnets and learning connections that transcend the silos of official curriculum areas.

The Fonua model by Sione Tu‘itahi (2005), for example, can provide logical (fonua) contexts that help teachers/learners to think beyond curriculum silos to better appreciate how the fonua is central to everyone’s wellbeing. As Cobern (1991) stated:

> Science educators are well aware of the phenomenon of boxing Science as school knowledge. This is a learned behaviour that works against the long-term best interests of the person and of the disciplines involved. Thus, if one takes seriously the concept of worldview and the assertion that all experience is continuous, then one can state with considerable assurance that the beliefs and experiences students bring to the classroom influence their learning experiences in the classroom. (p 543)

While this exploration of fonua reflects a Tongan cultural construct, similar concepts may exist within the diverse communities of Vanuatu as seen in the work of Hess (2009).

Another approach worth considering in both countries could involve learning about socio-scientific issues (issues where science and society intersect), by using a method of contextualised instruction (Hancock et al., 2019). Authors like Maddock (1981 as cited in Aikenhead 1996), for example, have long observed that "science and science education are cultural enterprises" (p. 1). Hence, I also agree with Lemke (2000) who eloquently proposed that:

> To study natural phenomena as if we were not in society and as if they were not interacting with society, through us and through technologies that will amplify and ramify those interactions indefinitely and unpredictably in the human future, is today simply unscientific and irrational. Not to study women's health, global warming, nuclear power, or space exploration by the methods of both the natural and social sciences is pointless (p. 309).

In this light, it was not surprising to find that a sense of being connected to place was identified as being important to the students I met (in both communities). The Ha'apai students displayed this through their emphasis on the passed down inheritance (known in Tongan as tukufakaholo) of land and oral traditions (see Chapter 6) which can be related to the preceding discussion on fonua. All students appeared to enjoy sharing their stories of a place. Port Vila student Casillas, for example, actively sought out stories of place. He particularly loved stories about the explorer De Quiros arriving in the Big Bay of Santo, which he said was his favourite place (because this was where he would need to go to hear and see these stories). He also sought out stories from his grandparents about traditional food from his home village in Santo, demonstrating the cultural significance of stories in intergenerational transmission of TEK.

Another site of significance held dear by the Port Vila students was Hat Island. This is where Chief Roimata was buried with his 100 wives alive – as the students collectively emphasised to me! The story associated with this place have left such a powerful legacy it has been accorded the status of a World Heritage Site and people are not allowed to live. As Cattleya said, an "atmosphere of history" has been preserved on that island – capturing the students' imagination. Indeed, in relation to archaeological research, oral traditions played a

key role in determining the exact location of the burial site of Chief Roimata and the people buried with him (Shing, 2006). The Port Vila students' interest in Hat Island and WWII sites such as Million Dollar Bay and the site of the wreckage of the SS Coolidge in Santo demonstrates that landscapes and seascapes are 'storied' and 'living' (Calderon 2014; McCoy 2014 and Tuck et al. 2014 as cited in Wooltorton et al., 2020) .

Stories of place were also popular among Ha'apai student participants who told me of matanga, or significant historical-cultural sites. They also advised me I needed to ask specific elders for the stories about these sites. Thus these stories, part of Tonga's rich oral culture, also provide a rich well for science teachers and students to draw from with guidance from custodians of this place-based knowledge, particularly given their fluency in the Tongan language, which may also help to preserve this knowledge (Lātū, 2017). Ishaani shared an example of this with me, when explaining the meaning of Tongoleleka's name – which is tied to its past ecology and abundance in the mangroves. As a teacher-researcher, I was left asking myself: *How can we use such stories to contextualise our teaching of important scientific concepts and intentionally engage our students with culture and place?*

From my observations, I would conclude that Year 10 science educationprogrammes in both Port Vila and Ha'apai are largely classroom-bound and entail much passive learning. The vast majority of learning is exam-focused and conducted in physical environs removed from the lived landscapes/communities of the students. Students in both communities, therefore, are often required to sit in classrooms and learn about distant places, from secondary sources (like textbooks), rather than from primary data collected on site at places of cultural significance to them. However, Thaman (1999) has pointed out that among Pacific peoples' "worldviews are closely linked to their vanua/ples/fonua concepts, which are inadequately translated to mean "land" or "place," but which embody social and spiritual as well as physical dimensions" (p. 69). How could these concepts be considered within curriculum development?

In a science classroom, I am increasingly inclined to agree that we teachers of science in Pacific communities must recognise that "science education always occurs within a place" (Macfarlane et al., 2019, p. 457). We should also take note of the work of Orr (1992), as cited in Cutter-Mackenzie and Smith (2003), who presented *ecological literacy* as conceptualising relationships between the environment and people. Further research may explore how ecological literacy holds synergy with the concepts of fonua (from Tonga) and man ples (from Vanuatu) discussed elsewhere in this thesis. Given the ongoing urbanization witnessed globally, Orr (1989) proposed that conservation education must bring students in contact with natural systems to avoid nature becoming increasingly abstract to students living in urbanised

contexts. This is a particulary important consideration for science education in urban Pacific centres such as Port Vila.

Students in both case study locations (Ha‘apai and Port Vila) showed a keen awareness of environmental issues in their communities and their surrounding areas. Moreover, the teachers I met in both locations often spoke highly of students’ knowledge of the environment, particularly those from more rural communities. They paid particular attention to sea-level rise, coastal erosion and shortage in the freshwater supply after the Category 5 TCs they endured. These experiences beyond the school gates, however, were not central to the official curriculum of either country. Rather, what I witnessed in schools largely focused on preparing Year 10 science students to write responses (using the medium of the English language) to a set of standardised summative assessment questions. Yet there is scope in official curriculum guidelines to adopt a more place-conscious approach to teaching. Take for example, some of the following examples of learning outcomes that are relevant to the land and culture – from the Tongan curriculum:

> ***i.*** Discuss … different feeding relationships existing amongst living things in the community in Tonga ii. Draw, label and explain the importance of nutrient (carbon and nitrogen) cycles. (*Science Syllabus For Secondary Schools in Tonga Class 9 – 10*, Tonga Ministry of Education and Training, 2015, p. 32)

> ***B13.*** Predict some of the probable effects of the elimination of one species from a given food web … ***B15.*** explain and use appropriately the terms “introduced species” and “biological control” referring as appropriate to Lantana, the African snail and guppies as local examples (*basic science for Vanuatu Year 10 Teacher’s Guide*, Vanuatu Ministry of Education, 1997, p. 51)

To make genuine links between the above learning outcomes (which attempt to use local examples), there needs to be greater permeability between the content of a science course and the students’ worlds. This would inevitably require a pedagogical approach that ensures learning is relevant and builds on students’ cultural capital rather than ignoring it (Bourdieu, 2002). What I would propose, therefore, requires the development of environmental education programmes in Tonga and Vanuatu which revolve more around the students’ worldviews (considering cultural, religious, ecological, familial and linguistic factors), identities and lived world (authentic) experiences.

Stories can be drawn from students’ lived experiences, from their elders and also from religious traditions such as Christianity, which many of the participants identified with. I found the students of Future College (Port Vila) were capable of articulating the tensions they felt existed between Christian beliefs about the world, their (Indigenous) kastom beliefs and the

western scientific beliefs taught in their science class. The process of identifying such tensions may provide opportunities for teachers to co-plan and co-develop develop critical inquiries which enable students (and their families/communities) to evaluate multiple perspectives of pressing environmental problems confronting them. Also, to identify where and how these differing perspectives or forms of knowledge may converge and diverge.

Port Vila students, for example, identified the tensions they felt sat between the three human origin stories found in the traditions of kastom, Christianity and science. Christianity's human origin story found in the book of Genesis in the Bible, was famously proposed by White (1967) to instruct humans to dominate 'nature' as a commodity. However, my own personal reflection on Christian scriptures such as Psalm 24:1 which states "The earth is the LORD's, and everything in it, the world, and all who live in it" (NIV Bible, 1978/2011) seems to imply human responsibility, inspiring prayers such as "Teach us to care creatively for [earth's] resources" found in *A New Zealand Prayer Book* (Anglican Church in Aotearoa, New Zealand and Polynesia, 1989/2021, p. 413) . In the same vein, Tongan theologian, Rev. Dr Tevita Tonga Mohenoa Puloka (2017b) highlighted the intrinsic worth of the earth simply because it was created by God. This raises a question for further research, what support would teachers find helpful in exploring ecological implications of biblical teaching (Orr, 1992, p. 11) with their students in culturally sensitive ways?

Approaches such as tufala save (literally 'double knowledge' in Bislama), as mentioned by Fair (2018), may also be useful in assisting students to consider multiple epistemologies in relation to climate change. This inclusive approach may help to avoid alienation of Indigenous peoples of Vanuatu from climate change discourse. In both Ha'apai and Port Vila, family was identified by participants as an important context for environmental learning. The familial learning identified by participants often involved activities, stories and places significant to their families. In Ha'apai, I noticed that land ownership seemed to be an issue the students strongly associated with their cultural values and family identity (see Chapter 6). The Ha'apai students, for example, believed it was "wrong" to sell family land for money. Similarly, they did not feel the risks of potential profits of deep-sea mining were worth the risk of harming the fonua.

I also found that teachers in Ha'apai and Port Vila all agreed that their students' place-conscious/traditional ecological knowledge was strongly attached to their family ties. While place-based knowledge is best experienced outside of classrooms, in the places being studied, as 'affective' leaning (Manning & Harrison, 2018), the teachers were striving to overcome the physical constraints of their classrooms in ways that sought to enable learners to cognitively

recognise how these classrooms were now a gathering place for people from various areas – holding the potential for the co-construction of new environmental understandings of our local places and culture.

This was best illustrated by Tōnunga's description of her students' in-depth knowledge of the sea between islands including their awareness of species abundance and diversity found between the islands of Haʻapai. I encountered similar perspectives when Port Vila teachers acknowledged students from Santo who possess TEK regarding endemic species. I also found that food culture, and food sovereignty, are also vulnerable to climate change and changes in cultural practices. Haʻapai students, for example, described the shortage of prestigious traditional root crops such as ʻufi (yam) during the drought that followed TC Ian. Port Vila students similarly described learning traditional food culture and preparation methods – from their grandparents using local food sources. This highlights learning about food sovereignty in science classes in Tonga and Vanuatu and the Pacific region as an area of future research for foregrounding TEK within the curriculum similar to research done by Meek et al. (2019) and Meyer (2014).

Ultimately, I feel that science in Moana communities must always remember that the places that they and the students inhabit are socio-ecological sites (Gruenewald, 2003b) and that we need to be attentive to the dynamics of different places when planning the design, delivery, assessment and evaluation of science educationprogrammes. From my review of the international literature, and given what I have observed during talanoa in Haʻapai and Port Vila, it seems only logical to me that PBE approaches hold the potential to increase "the permeability of boundaries between schools and communities" (Smith, 2002, as cited in Preston, 2015, p. 42) . I would add, likewise, that knowledge of Indigenous/local community languages is needed to enhance the teaching of science in these communities.

Theme Two: Indigenous languages as gateways to learning

The communities I visited in Port Vila and Haʻapai both experienced British colonisation to varying degrees and both communities continue to be shaped by the forces of globalisation. Subsequently, the historical legacy of the British schooling system, persists strongly within both schooling contexts and has resulted in the privileging of English as the language of instruction and assessment. A consequence of this is that authoritative sources of knowledge are chosen based on the language they are written in – English. For example, the *basic science for Vanuatu Year 10 Teachers' Guide* (Vanuatu Ministry of Education, 1997), recommends resources for teaching that include laboratory equipment and textbooks but do not

make any recommendations for how to engage with community holders of TEK. When conceptualizing language as a gateway, we must recognise that the presumed superiority of English in science education can represent a closed gate to incorporating Indigenous knowledges that are "developed, encoded and transmitted" (Maffi, 2005, p. 601) in Indigenous languages.

In both communities, teacher participants expressed similar concerns over their students' English proficiency levels when being exmained in the English language. The Port Vila teachers emphasised that their students were much more proficient in Bislama. Meanwhile, the Ha'apai teacher participants felt their students were also disadvantaged because their students were far more proficient in Lea Faka-Tonga (the Tongan language). Particularly in the Ha'apai setting, the teacher participants viewed practical (authentic) assessment activities as possessing the potential to provide more equitable academic outcomes for the participating schools and students. Some students in both sites had aspirations to raise awareness about environmental issues and I would contend that speaking the languages of the communities would lead to more meaningful efforts in doing so.

The student participants in both research settings (Ha'apai and Port Vila) were already engaged in culturally meaningful environmental learning (TEK) outside of school and moreover, they were learning about local ecologies and ecosystems – using the Indigenous languages (to varying degrees) of their communities and families – in settings beyond their classrooms. As a teacher, this finding left me feeling concerned that school science assessments (especially national examinations) were conducted exclusively in English and primarily through written means. Based on my observations, talanoa and literature review, I now believe that this trend does not just reduce the potential for students to achieve equitable academic outcomes. Rather, it produces academic outcomes that may often reflect poorly on the quality of teaching conducted by teachers who sought to resist the privileging of written English assessments by use of alternative forms of formative assessments and pedagogies, such as efforts made by Ha'apai teacher Tōnunga (discussed in Chapter 5).

All the participating schools in this study (Tonga and Vanuatu) similarly expected students to complete summative assessments in written English, necessitating English proficiency as the medium for expressing their understanding of complex scientific concepts. It also soon struck me that in all the schools participating in this study (Ha'apai and Port Vila), science notes and textbooks are the key pedagogical props available to teachers and that in both instances, they were always written in English. As a result, there were times when I witnessed teachers sometimes adopting the role of language translator in the midst of a science lesson.

This left me asking myself who really benefits from the "hierarchization of languages to global and local power relations" (Skutnabb-Kangas, 2009, p. 37). As Otsuka (2007) has suggested, this approach to science education endangers Indigenous languages as proficiency in the colonial language appears to present more socio-economic advantages (such as access to higher education and future careers).

While there are doubtless benefits of speaking English, we must, as Pacific teachers of science in Pacific communities also critically evaluate how we engage with this post-colonial force of globalisation (Otsuka, 2007). The privileging of one colonial language (i.e. English) as the sole medium for instruction in science education may result in children being "forcibly transferred to the dominant group linguistically and culturally" (Hough & Skutnabb-Kangas, 2005, p. 107). As a teacher in Tonga, this finding has helped me to recognise that academic achievement in science education requires not only proficiency in the English language, but the ability to remember, and regurgitate, the correct 'answers' about foreign concepts as required by the *Structure of the Observed Learning Outcomes* [SOLO] *Taxonomy* which was introduced to schools in Tonga in 2015 (Lātū, 2018, p. 2).

From reflection on this theme, our application of the Solo Taxonomy in written examinations in Tonga now concerns me, for example, that my students are not rewarded for the depths of their understanding but, rather, their ability to recite a series of 'correct' formulaic answers in an exam conducted in a foreign language (English). I strongly agree with the observation of 'Otunuku et al. (2017) that "As the normal practice in Tonga is that exams are written in English, except for the Tongan language studies papers. It is highly likely that the students with higher English language proficiency are advantaged while others are discriminated against by their skills in a language that is not their own" (p. 18).

In 2021, it was announced that only 28% of Year 11 students in Tonga in 2020 passed the *Tonga School Certificate Examination* and only 27% in 2019 (Tonga Ministry of Education and Training, 2021). These results raise the question of whether it is the assessments which are actually failing students. This, in turn, leads to academic outcomes that I feel contributes to the reproduction of a series of social inequalities as described in more depth by writers like Tatafu et al. (1997).

A key finding to emerge from this research, therefore, has been the fact that youth in my two case study locations *are* learning TEK outside of school from their grandparents, family members and other community elders. Participating students in Ha'apai were all proficient in Tongan, as demonstrated in our talanoa which were held in Tongan. However, in Vanuatu, which has a great diversity of Indigenous languages, all the participants in Future College (Port

Vila) reported not being able to speak their (Indigenous) vernacular language, responding in Bislama when their families spoke to them in their Indigenous languages.

If students in Port Vila do not acquire the level of Indigenous language proficiency required to meaningfully communicate with their elders, their community's intergenerational transmission of TEK could easily be disrupted or even lost. Kraemer (2013), for example, has found that many youth, who grew up in Port Vila, are not gaining access to the socio-ecological knowledge they need to connect with their parents' islands. Such knowledge includes vernacular languages which serve as gateways to learning beyond the walls of their classrooms. He gave this example from his ethnographic study in Freshwota:

> … when the grandmother of one of my adoptive families came from the rural islands to visit, she criticised her son for not having taught his children their Indigenous language. She expressed sadness at her inability to properly communicate with her grandchildren as they do not speak her language and as she does not speak very good Bislama. She said that although she wants to tell her grandchildren stories about the island, she finds that the limited vocabulary of Bislama hinders her ability to convey the information. (Kraemer 2013, p. 89)

Language therefore seems to be like a cord tying generations together, and allowing knowledge and skills to be shared across generations within a family/community. When this cord is cut, future generations suffer as they lose connections to place and the TEK of that place. While schools in Port Vila privilege English as the language of instruction and assessment, learning TEK may require a level of proficiency in vernacular languages – not recognised in the Vanuatu science curriculum. This despite the fact that McCarter and Gavin (2011), when conducting research in Malekula, Vanuatu, also found that there is a need to extend students' proficiency in vernacular languages to draw connections to the land. The importance of proficiency in Indigenous languages to the study of environmental science in Vanuatu and Tonga needs to be considered by educators – especially in this climate crisis.

Theme Three: Marginalization of traditional ecological knowledge in science education

Another recurring theme to emerge from my analysis of data collected in Ha'apai and Port Vila suggests that the official curriculum guidelines for science education in Tonga and Vanuatu privilege Eurocentric knowledge with limited engagement with TEK. I remain optimistic, however, that science education programmes can be transformed to enable teachers and students, alike, to tackle local environmental issues. My research findings (Chapters 5 to 8) suggest that this can be achieved by identifying what and where the TEK shared at home can be ethically interwoven with the school curriculum. Such an approach must enable students

and teachers alike to see the many ways that western scientific and Indigenous knowledge systems can coexist in ways that diverge and converge to achieve positive results for all stakeholders. My position subsequently reflects Jennifer D. Adams' assertion that:

> By encouraging Indigenous knowledge systems inside the classroom, by embracing and valuing them, and blurring the "borders" artificially separating the classroom and community, we create science learning experiences that are relevant to creating an ecologically and culturally sustainable future. (Adams, 2010, p. 335)

During my talanoa in Haʻapai and Port Vila, I found that students in both places were equally quick to highlight that TEK is important to them, their communities and their older family members. To allow students to enjoy authentic learning activities that will enliven the teaching of science, it has dawned on me that schools in Tonga and Vanuatu need to support their science teachers to strengthen relationships with students' families. This will, in turn, better allow students' familial/community funds of knowledge (such as knowledge of marine ecology embodied in traditional management of marine resources or seafood gathering practices as discussed in Hickey (2006) and Malm (2009)) to be incorporated into the design, delivery, assessment and evaluation of science educationprogrammes.

While Gonzalez et al. (2005a) propose to position people as funds of knowledge, I would adapt this logic to fit better a Moana understanding, one which focuses more on the socio-spatial spaces found between two or more human beings that constitute relationships (i.e. vā as discussed in Kaʻili (2005)). Therefore, it is the relationships, between people, which constitute funds of knowledge. While genealogically determined relationships may serve as gateways to access to knowledge, this knowledge remains part of a relationship not to be mined, modified and marketed through research but respected, acknowledged and ethically shared. As Linda Tuhiwai Smith (1999) warned "in a very real sense, research has been an encounter between the West and the Other" (p. 8). Therefore, any attempts by teachers (staff of western institutions) to incorporate TEK into science curricula guidelines must be done in an ethical manner that is consistent with the cultural expectations/obligations/values of the local Indigenous community concerned.

In Port Vila, teachers used dialogue with students to gain access to insights about the TEK held by the students' parents, as well as participation in cultural activities facilitating the transmission of TEK from one generation to the next. Their students, however, also showed awareness of the tensions that exist in the space that sits between TEK, Christianity and western scientific beliefs. The confusion they described feeling points to the need for teachers to engage with these tensions to better support them navigate multiple perspectives, to cross cultural

borders (not assimilate) and enter into the world of science to understand how it relates to their everyday life experiences as young Indigenous people (Aikenhead, 1996).

This finding aligns closely with the concerns of the Tongan teachers who participated in my research. They desperately wanted to make learning more practical/relevant to engage students as well as to respond to the pressing environmental problems surrounding them. From them, I also became aware of the cultural sensitivity required to engage with local environmental issues, particularly for teachers not originally from the communities they teach in. This became even more evident to me when I reflected upon Ha‘apai students’ deep concern for tukufakaholo (passed down inheritance) which implied cultural and geneological ties to place. This calls for strengthened relationships between teachers and the local communities surrounding the schools to enable culturally meaningful engagement with local environmental issues through practical means (i.e. replanting of coastal vegetation as a response to sea-level rise and coastal erosion).

The teachers who participated in this research also introduced two avenues by which they felt TEK could become part of school science learning when they emphasised the pedagogical merits of (i) practical (i.e. authentic/experiential) learning activities and, (ii) meaningful dialogue. Teachers in Ha‘apai highlighted their preference for experiential learning, while Port Vila teachers stressed the potential of engaging their students via more inclusive dialogical practices in the classroom. I remain uncertain, however, that dialogical pedagogies and practical learning activities are compatible with the teacher-centred (behaviourist/constructivist) pedagogies prescribed in Tonga and Vanuatu. In both instances, it appeared to me that the style of teaching was primarily influenced by doing what was necessary to equip students to pass their national examinations. This concerned me because as Kolb (1984, p. 26) explained, “learning is best conceived as a process not [the measurement of] outcomes”.

As a result, I would propose that Port Vila school leaders consider re-imagining the position of schools in communities to explore how they might better support the ethical incorporation of TEK into the science curriculum. Indigenous principles of social cohesion and harmony like feveitokai‘aki (mutual respect), as discussed previously (see Chapter 3), is essential to this learning partnership between schools and communities. Students would have much to learn from and offer to local communities if they can only be given a chance to serve them as ‘Citizen Scientists’, engaging in scientific research that would benefit their communities (Phillips et al., 2019).

For example, students could work on building a medicinal nursery using Indigenous plants or monitor a nearby coral's health, or replant coastal vegetation such as mangroves to combat coastal erosion. By working alongside community members on Indigenous place-based curriculum activities, a greater potential for dialogue between home and school arises. However this would challenge some teacher perceptions that their job is done inside not outside the classroom (Tambe, 2004). Therefore, one might ask, 'why is this approach urgently needed?' My review of the literature points to the work of Pond (2011), who observed that:

> Tonga is losing its own knowledge of the Oceanic biota. I recognise four allies in attempting to recover this treasury. The first allies are Tonga's unsung gardeners (fa'a) and fishermen (toutai) … The second ally is the body of knowledge held collectively in the Austronesian language family. The third is international science itself with its investigative technology … The fourth is international recognition that the planet is facing an ecological crisis … (pp. 85 - 86).

Community partnerships typically employing Indigenous place-based pedagogies could, potentially, serve as the essential doorway leading out of the colonial classroom environment and into culturally and ecologically meaningful learning experiences in immersive ecosystems such as coastal areas. This pedagogical approach may well be liberating for the teacher who is no longer expected to endure the pressure of being the sole source of knowledge the learning community. Rather the teacher would be expected to role model learning strategies by learning from the holders of TEK – working alongside their students. The Ha'apai teachers reported learning alongside their students as very enjoyable.

This place-based curriculum approach may also be empowering for the local community's custodians of TEK, whose knowledges and languages have been historically marginalised by schooling systems (Koloto 1998; McCarter & Gavin, 2011; Thaman, 1999). This may, in turn, spark innovative thinking and curiosity amongst students who can now see and feel the connections that exist across 'western' disciplines, cultures and language barriers, whilst helping them to recognise the importance of context in learning science.

Theme Four: Contextualisation through dialogue

Paulo Freire (1970/2005) denounced the 'banking model' of education, whereby teachers effectively 'deposit' information into their students, who must then memorise this content without critically thinking about it. In exchange for this banking model, Freire (1970/2005) proposed problem-posing education. A problem-solving approach would require that teachers of science and their students become engaged in 'dialogue' with each other, rather than the teacher's sole interpretations of the textbook and/or world surrounding around them:

> Through dialogue, the teacher-of-the-students and the students-of-the-teacher cease to exist and a new term emerges: teacher-student with students-teachers. The teacher is no longer merely the-one-who-teaches, but one who is himself [sic] taught in dialogue with the students, who in turn while being taught also teach. They become jointly responsible for a process in which all grow. (Freire, 1970/2005, p. 80)

During my research, I too found dialogue was a powerful tool for enhanced learning in science educationin the two contexts central to this study (Haʻapai and Port Vila). Firstly, I found that dialogue between teachers and students helped teacher participants learn about their students, their communities and local knowledge of surrounding ecosystems. For example, this helped the teachers, gain knowledge of their students' worlds and to better recognise the gaps between these lived world experiences and those privileged in the curriculum and textbooks – that were abstract, grounded in environmental experiences elsewhere and presented in a foreign language. An example of this was when Tōnunga in Haʻapai advised me she had experiences with students from the outer islands of Haʻapai, of learning about their in-depth knowledge of marine environments but also their unfamiliarity with concepts presented in curriculum such as deforestation. Port Vila teacher Rebecca used students' experiences of earthquakes in various outer islands of Vanuatu to teach about plate tectonics. There is potential for curricular design to empower teachers to explore climate change concepts relevant to students' communities and build from there to experiences faced by communities elsewhere.

This sort of dialogue between science teachers and students was, however, still determined by the rigid parameters of curriculum content and the teachers needed to work hard to ensure their dialogue with students was 'relevant' to a curriculum not grounded in local places the students were familiar with. I am, therefore, inclined to still feel that their best efforts still largely reflected aspects of the banking model because "the teacher chooses the program content and the students (who were not consulted) adapt to it" (Freire 1970/2005, p. 73).

The talanoa central to my research in both countries constantly reminded me that dialogue remains integral to the transmission of TEK and thus central to how young people learn about their local environments in familial and community settings. This was quite noticeable when the Haʻapai and Port Vila Year 10 science students volunteered stories of learning about their local environs, flora and fauna from older family members or community members. Through this intergenerational/dialogical transmission of TEK, students became aware of Indigenous knowledge systems, particularly those embodied in the kastom stories of Vanuatu and the tala-ē-fonua of Tonga.

Students in Haʻapai, for example, advised that we need to ask elders about stories of place, rather than read a book about that place. The Port Vila students, similarly, emphasised

that understandings of place are passed down through (oral) stories. Hence, I was left wondering whether the future delivery of science educationin both places/countries may need to be inclusive of local oral narratives as pedagogies? In their 'out-of-school learning', most of the students seemed to have more agency over what they learned in their familial/community relationships. For example, Casillas could request what stories about their culture he wanted to hear from his grandparents, and so he requested to hear stories of their traditional food. This may have helped to build in him a sense of belonging and identity to his village in Santo, even while he is away in Port Vila for schooling.

Within science education, argumentation has been promoted as a practice that mirrors how scientists reach a common understanding (Ping et al., 2019). Hence, enabling students to have opportunities to engage in forming arguments has been proposed by Osborne (2009) as a means to allow students to develop their capacity to reason, promote conceptual understanding and increase dialogue in the classroom. While questioning and debate are valued in science education for developing critical thinking, these are not necessarily encouraged in teacher-centred classrooms in Tonga, nor in many families in Tonga (Bay et al., 2016).

Rather than viewing silence as a weakness, some curriculum planners/teachers may reconsider silence as being something that is culturally grounded as has been explained below by the Samoan scholar Patisepa Tuafuti:

> Silence is not passive. It is an active behaviour that conveys culturally appropriate, meaningful messages that cannot be expressed through verbal communication, or that are best expressed through silence ... Silence is an active and a living component of Pasifika culture. One of the basic components of cultural and communicative competence in the Pasifika is to know when, where and how to speak or be silent in various contexts. Silence is a symbolic and fundamental structure of communication. Pasifika peoples, especially elders, comprehend the whole framework that constitutes its (silences) meaning. (Tuafuti, 2010, pp. 2 - 4)

Given cultural differences in how language, silence and voice intersect and are used, my findings suggest teachers in Port Vila and Ha'apai build competency in encouraging student voice through a culturally acceptable "form of dialogical engagement" (Sanga et al., 2020, p. 1). My findings from teachers and students in Port Vila and Ha'apai affirm the statement made of Indigenous peoples' acts of resistance: "our stories, local and global, our communities, cultures, languages and social practices – all may be spaces of marginalisation, but they have also becomes spaces of resistance and hope" (Smith (1999), p. 4 as cited in Sanga et al., 2018, p. 5).

Inviting students to share stories of environmental change as witnessed in their place became a means of students engaging in talanoa in this research. Havea (2020) also effectively used talanoa as pedagogy for Climate Change Education in Ha‘apai. Warrick (2009) also highlighted the importance of sharing stories in Ni-Vanuatu culture, captured by the Bislama phrase storian. Indigenous forms of dialogical pedagogy in science education in the Pacific is an area deserving of more research given also the complexities of sharing collectively held Indigenous knowledge for non-traditional purposes (Ratuva, 2009; Sanga and Reynolds, 2020).

Teachers may perceive risks in enabling students to consider/discuss multiple worldviews, particularly those that might collide with one another. This finding aligns with the work of Palefau (2005) who, like me, also noticed that “some of the ideas and rules of school Science are totally against what Tongans are expected to believe at home through their myths, beliefs, cultures and stories. On the other hand, some help them in their daily life” (p. 127). Herein lies the power of dialogical pedagogy, where dialogical partners can critically reflect on their conversation and make sense of it based on their shared and differing values and experiences.

Teacher and student dialogue provides an authentic and empowering way of allowing students to explore and critique science, especially those aspects of science education that may contradict their own beliefs about the world. Tok stori, for example, involves a contextualised, dialogical pedagogy that may hold the potential to transform the teaching of science in Port Vila. In essence, tok stori, as described by Sanga et al., (2020), may enable teachers to ‘open’ a science topic for teachers and students to co-identify connections between science and other knowledge domains.

For example, Sanga et al., (2020) in their Solomon Islands research – explained how biblical stories were linked with stories of institutional leadership in a community. As Sanga et al., (2020) explained, this lets tok stori participants own their own learning and create relevance by relating it or reconstructing links with, for example, their faith. Of particular interest to this researcher is the rhythm of tok stori identified by Sanga et al., (2020), who suggested that tok stori involves a ‘movement’ from ‘I do’ (personal example), to ‘we do’ (collective examples given) to ‘you do’ (recommendation for a sample case given). In relation to science Education, I suspect that this dialogical movement may hold the potentital to be useful when discussing (via a tok stori process) local environmental issues grounded in Vanuatu school settings.

I must, however, also place a caveat upon this observation, given that this ‘rhythm’ was identified by Sanga et al., (2020) during tok stori conducted among Solomon Island

participants. Given my limited exposure to Ni-Vanuatu culture, I can therefore only recommend that Ni-Vanuatu researchers consider the possibility of exploring/verifying whether a similar rhythm is found in Ni-Vanuatu tok stori processes that could be adapted to enhance the teaching of science. While I found similarities in both sites visited (Ha'apai and Port Vila), I also encountered some unique contextual issues. These are unpacked in the following section.

Part two: Unique contextual issues and complex local realities

Ha'apai (Tonga): Unique contextual issues and local realities shaping participant responses

As mentioned elsewhere, the Ha'apai island group is made up of sixteen inhabited islands in the Kingdom of Tonga, with the administrative capital located on the island of Ha'apai. Ha'apai has one Indigenous language shared with the rest of Tonga and this reflects the relative linguistic homogeneity and hierarchical nature of Tongan society (which comes complete with an honorific register). As a constitutional monarchy, and the last remaining monarchy in Polynesia, Tongan society is, unlike Vanuatu, highly stratified. Tongan people are born into specific culturally defined fatongia (roles) based on aspects of their identity – birth order, age, clan, gender and most importantly, social class. There are three social classes in Tonga, the commoners, nobility and royalty, and just as the verbs used in the Tongan language change for each social class, so do the actions expected of each class (Faka'osi, 1993; Uasike, 2001).

How do these features of language and culture impact students' and teachers' responses in Ha'apai? I can best answer this question by recalling a student's blunt response to my question about their fatongia in the environment. While other students spoke of taking positive environmental actions such as planting mangroves in coastal areas, she replied that she did not have any fatongia (role) due to her age. Interestingly, Havea (2020) designed a curriculum intervention with students in Ha'apai. This empowered students to share the new knowledge they had learnt about climate change at a Climate Change Expo – by using a process Havea termed "talanoa kavekavehoko" (pp. 244 - 245). This was proceeded by two forms of discussions: (i) Talanoa fakatoka (in which the students presented their understandings of climate change) and (ii) Talanoa felāfoaki (in which the students presented new ideas of climate change they had co-constructed). This innovative use of talanoa as pedagogy seemed to build students' confidence in sharing their concerns about climate change with their communities which included their parents.

Although Ha‘apai has one (shared) Indigenous language, Lea Faka-Tonga, further research is needed to explore how the status of English as the language of assessment in science educationin Ha‘apai shapes the socioeconomic environment of the Tongan language (Otsuka, 2007). In turn, further research is also needed on how the status of TEK is regarded given the privileging of English in science education in Ha‘apai. This is particularly relevant given climate change adaptation measures such as EbA which incorporate traditional or local knowledge of ecosystems held by communities (Pedersen Zari et al., 2020). Involving students in community EbA projects may be a way to help them realise the value of TEK alongside western science in combating climate change.

Research regarding teaching sustainable traditional methods as alternatives to consumerism as suggested by Bowers (2002) may also help students and teachers realise the importance of preserving Indigenous cultures and languages which support the intergenerational transmission of cultural knowledge such as TEK (Maffi, 2005). An example of a sustainable traditional alternative, as suggested by a participant in Havea’s (2020) research in Ha‘apai, is the wrapping of lū (a popular traditional dish baked in the underground earth oven) in bananna leaves rather than in foil as is commonly done today. Incorporation of TEK into science notes was already happening in Ha‘apai through the efforts of Tōnunga. However, further research is needed on how this incorporation of TEK into science lessons could be expanded to help emergent bilingual students, more proficient in their Indigenous language (such as those in Ha‘apai), simultaneously learn scientific concepts in the English language (similar to the contextualisation described by Tolbert et al., 2019) required for assessments.

Port Vila (Vanuatu): Unique contextual issues and local realities shaping participant responses

The legacy of the joint colonial administration of the UK and France from 1906 to 1980 (Rawlings, 2012) is still reflected in the schooling system given the divide between Anglophone and Francophone schools (Vanuatu Ministry of Education, 2010). Unlike Tonga, Vanuatu is reported to have the highest density of linguistic diversity (François et al., 2015), a reflection of the high cultural diversity within that country. This diversity inevitably impacted upon the Port Vila teacher participants’ responses to questions about their pedagogies. However, teacher participants valued student voice in the sense that it provided a valid source of access to a diverse range of TEK in their science classroom. They particularly highlighted students who came from outer islands. This is a similar finding to the Ha‘apai case study, although Port Vila classes would be more linguistically and culturally diverse.

The urban context of Port Vila, and its status as a metropolitan hub in the Pacific, also positioned it much differently to the remote community I experienced in Haʻapai. As a gathering place for students from around Vanuatu and elsewhere in the Pacific, the cultural and ethnic diversity of this place was reflected in the profile of my Port Vila research participants (see Chapter 3). However, according to *Vanuatu National Curriculum Statement* (Vanuatu Ministry of Education, 2010), "the language of instruction in our schools will either be English or French" (p. 59). Further research is needed to see how the maintenance of colonial languages in schooling represent a 'closed gate' to the cultural diversity in Port Vila from being meaningfully engaged with through science Education.

As one teacher acknowledged, this socio-cultural diversity does constitute a barrier to incorporating every student's TEK or vernacular language into the science curriculum. In light of the diversity of cultures in Vanuatu, I was left wondering "whose culture and whose language would be privileged in a Port Vila basic science class attempting to engage with TEK?" I suggest further research is needed to explore the historical development of science education in Vanuatu, and to examine how/why these historical trends may have shaped the current curriculum and/or potentially run the risk of negatively informing future curriculum developments. To conclude, my research suggests more dialogue is needed among science educators and communities in Port Vila to determine how and what TEK could be incorporated into basic science education, especially when considering the complexities of imminent environmental and cultural change.

Part three: Implications for science education in Haʻapai and Port Vila

In consideration of the four recurring themes shared previously (Part One), plus the distinctive features of each case study context discussed above (Part Two), this final passage (Part Three) offers a series of implications for science education – arising from this study. The implications are presented in a form to inspire further talanoa among educators and all other interested stakeholders about what science educationcould achieve if it is proactively inclusive of Indigenous TEK and place-conscious pedagogies.

If education is, as Konai Helu Thaman (2009) asserts, "worthwhile learning" (p. 1) then my research suggests it is worth asking what constitutes worthwhile knowledge when teaching science in communities facing challenges posed by climate change and globalisation? From my perspective, some critical questions must be asked with regard to the future design, delivery, assessment and evaluation processes of science educationcurriculum guidelines in

Tonga and Vanuatu. My stance, consequently, aligns with the ethos of the Rethinking Education in the Pacific movement.

Due to my talanoa experiences in Ha‘apai and Port Vila, I share that movement’s desire to see Pacific values and culture placed at the front and centre of schooling for Pacific communities, particularly those in Tonga and Vanuatu. If the Pacific science of fibres can be taught via an integrated curriculum by making a Tongan tapa cloth – and the properties of rocks retaining heat can be explored through making laplap in Vanuatu – why not integrate the practice and language of this TEK within science educationprogrammes? In the process, teachers, students and communities would participate in the co-production of Indigenous TEK and actively demonstrate that it is possible to relate that co-production to western science in ways that benefit a local community. The Pacific peoples of both places would also unashamedly assert that we too have our own Indigenous science and that it is: (i) transmitted through our culture and (ii) worth learning and passing on to the next generation.

Similarly, if a local marine ecology is learned through gathering sea food alongside mothers and aunties at low tide through the (Tongan) practice of fangota, why learn about marine ecology through photocopied pages of foreign textbooks in a distant, dry classroom? If Tongan and Vanuatu place names can tell of changes in local ecologies over time, why not empower our young people to ask an elder to share those stories with the class if, in exchange, the students may be able to undertake research that benefits that elder’s community?

Hence, I would propose that formal summative assessments provide opportunities for students to be assessed in the Indigenous language of the student/s being assessed. This would increase the likelihood of (Indigenous) students being able to demonstrate what they do know in their own Indigenous languages. I would add that such assessment tasks should allow for a wider range of mediums in which to share this knowledge, other than writing. Practical assessment tasks were, afterall, advocated by participants in Ha‘apai – because such tasks are integral to the maintenance of their TEK systems. In the context of Port Vila, however, summative assessment needs to be redeveloped, intentional dialogue among community members and educators is needed to explore “whose TEK” will be assessed, and how.

The last implication I wish to raise is on the role of the teacher of science, considering the challenges posed by climate change and its impacts, as well as societal change upon the peoples and places of both my research sites. I believe the findings of talanoa in Ha‘apai and Port Vila point to a higher call for teachers, one that transcends menial tasks of preparing and administering assessments, currently maintained by cultures of high stakes testing (Lumelume, 2007; ‘Otunuku et al., 2017). I propose that science teachers be supported and encouraged to

co-develop place-conscious community-based pedagogies in partnership with the students and communities they serve.

Conclusion

I began this research journey with the Tongan proverb, Pikipiki hama kae vaevae manava translated as, "*Link the outriggers of our canoes so that we can share our provisions with one another*" ('Ahio, 2011, p. 72), in order to liken this doctoral research project to a voyage across the Pacific. One where I voyage alongside other teachers, students and researchers to explore the research questions central to this study. To conclude, I now feel that science education can be repositioned to sit beyond the school gates and not just within the walls of classrooms. Rather my findings point to the need for greater connection and permeability between science classes and students' communities in order to meaningfully engage with local environmental issues. My findings suggest that science education can address global phenomena such as climate change and ecological degradation in locally meaningful ways within communities across the Moana (Pacific Ocean) by exploring its synergies with local place, language and culture through dialogue which extends beyond the classroom walls.

This can only happen, however, if science education is adapted to fit local community needs and provide students (and teachers) opportunities to learn science in their own languages, cultures and places. Given the challenges posed by climate change, it is imperative that I, as a Tongan teacher-researcher, also strive to empower my own students to participate in meaningful dialogue and activities that benefit their communities. When confronted by the ecological degradation and changing cultures eroding Indigenous knowledge bases around them, I can only conclude that it is vital that teachers in Tonga, Vanuatu and our wider Pacific region, engage meaningfully with Indigenous communities' custodians of TEK (as previously suggested by Palefau, 2005) to shape meaningful science curricula that equip students to live sustainably in local and global contexts.

Chapter 10 : Conclusion

Introduction

This research, from the outset, was likened to a journey across the Moana (Pacific Ocean) from Haʻapai to Port Vila and back to Tongatapu. It was primarily designed to explore how Year 10 students in Haʻapai (Tonga) and Port Vila (Vanuatu) conceptualise local environmental issues and how these were framed in their Year 10 science classes. It also sought to explore teacher perceptions of these environmental issues and the challenges and opportunities they saw arising from study of these locally. As a Tongan teacher/researcher, I took an autoethnographic approach and critically used talanoa research methodology to explore the research questions in the Haʻapai and Port Vila case studies central to this thesis (see Chapter 3). This data collection was further supported by classroom observations and analysis of relevant curricular texts such as science syllabi, plus teacher guides and notes provided by the teacher participants to their Year 10 science students.

Thus, the purpose of this chapter is to present lessons learned along this journey and implications for science Education. The structure of this chapter first describes the challenges I encountered during this research, and this description is followed by a summary of the thematic analysis work I undertook, pertaining to each research question. As a result of my analysis of data, I found the following four recurring (major) themes emerging from my talanoa with participants at each case study site (i) Connectedness to Place; (ii) Indigenous Languages as Gateways to Learning; (iii) Marginalization of Traditional Ecological Knowledge and; (iv) Contextualisation through Dialogue.

After reviewing the key findings relevant to each of these themes, the focus of this concluding chapter will outline the key lessons I have learnt from my research experiences in Haʻapai and Port Vila. Next, this chapter will present a section addressing how this doctoral research may contribute to knowledge in the field of education research. Finally, a concluding proverb is offered to emphasise what I consider to be the key implication arising from this study.

Challenges

After much critical reflection, I can now see that I have often had to juggle my roles as a researcher and a secondary school teacher in Tonga during part of the course of this doctoral research. As a result, my journey across the Moana has given me some cathartic experiences. As I heard the Port Vila and Haʻapai teachers' concerns regarding how they felt pressured for time and the resulting temptation to only 'teach to the test', I was forced to reflect upon my

similar frustrations. Like them, I too desire for alternative pedagogies that will engage students with science education activities, particularly those that involve authentic (practical and outdoor) learning tasks. Like the teachers I met in both communities, I too "had been experiencing a slow disconnection to people and places and my natural environment" (Fitzgerald, 2018, p. 3). Through these challenges I was left pondering:

> *Why could I as a teacher in urbanised Tonga, relate so easily to a teacher in a remote/rural setting of Tonga, to teachers in urban settings in Vanuatu and to teacher/researchers in Hawaii, like Fitzgerald (2018)?*

I also gradually found myself relating more closely to the hīnaki metaphor of McCarthy (1994) that Manning (2009) previously used to describe the frustration of history teachers in New Zealand. Like myself, and my teacher participants in Haʻapai and Port Vila, they too felt trapped by their institutional structures and timetables, much like tuna (eels) after swimming into a baited eel trap, or hīnaki. Once trapped within the hīnaki, teachers are unable to meaningfully engage with TEK custodians in their communities (Manning, 2009). This dawning realisation increasingly prompted me to question the colonial structure of schooling. A structure that has left the teachers participants (like myself) often feeling, walled-off from the surrounding environment, communities and cultures that could otherwise provide meaningful sociocultural contexts for Year 10 students of science. This realisation is repeatedly reflected in my analyses of the data collected from teacher talanoa data (see Chapters 5, 7 and 9).

When considering the potential limitations of this research, I must also acknowledge that it took place in bilingual and multilingual contexts. As an emergent bilingual person (English and Tongan), I found that conducting talanoa in the mediums of both Tongan and English languages helped me to reflect critically on the role of language in constructing meaning. Other researchers such as Havea (2020) and Faʻanunu (2017) have similarly highlighted the challenges of translating concepts about the environment, such as climate change, across English and Tongan languages. This, in turn, has nurtured a growing interest within me regarding the "links between the world's linguistic, cultural and biological diversity" (Maffi, 2005, p. 599). It has, moreover, increasingly caused me to question the use of 'English only' as the medium of instruction for science classes in multicultural and multilingual contexts.

To support my use of Tongan language throughout this research journey, Dr. ʻAna Taufeʻulungaki verified my Tongan translations of participant quotes and other quotes from Tongan literature presented throughout this thesis, unless otherwise stated. In those other

instances, translation work was supported by members of the Ha‘apai diasporic community. Although I was able to use English and Tongan in Ha‘apai talanoa, my talanoa in Port Vila were, however, limited to the medium of the English language only. As a result, I would recommend future research be conducted in Port Vila with students and teachers that allows for multilingual dialogue to take place. I believe this will help to further explore the recurring (key) themes arising from this doctoral study – especially regarding local environmental issues and how they sit alongside the meta-narratives of global climate change. Having explained some of the challenges I encountered, and how these were mitigated, I will now summarise key findings based on the research aims.

Key Findings

In response to my research questions, four recurring themes emerged from the various talanoa I facilitated and recorded in Ha‘apai and Port Vila (see Chapter 9). In that chapter, these four recurring themes were outlined for education stakeholders interested in pursuing “worthwhile learning” (Thaman, 2009, p. 1). These four themes are now further unpacked, below, to further underline the value of exploring teacher and student framings of local environmental issues within Pacific community settings facing threats of climate change.

Theme One: Connectedness to Place

Students’ conceptualisations of local environmental problems, such as sea-level rise, drought, TC recovery, pollution, deforestation, land ownership and coastal erosion were always underpinned by the various participants’ senses of feeling a connectedness to place. This connectedness was demonstrated by the storied land and seascapes discussed by participants of all ages, during the talanoa. Their narratives were laden with culturally based values about these places in ways that suggested to me that places can serve as moral compasses for those who possess these stories. In Port Vila, Year 10 students demonstrated an in-depth knowledge of historical sites of cultural significance. They also introduced the concept of tabu (taboo), which they described as a means to declare that an area is out of bounds and/or as a cultural strategy for supporting conservation efforts. In Vanuatu, taboo have long been used to inform marine management – such as the traditional method for limiting the quantity of turtles caught (Hickey, 2006).

Meanwhile students in Ha‘apai saw family land as an integral part of their family’s identity shown through their use of the concept tukufakaholo (defined as “handed down from generation to generation” (Churchward, 1959, p. 508)). Given this, they found it difficult to imagine commodifying their land and/or parting ways with it. The students of Lifuka,

alternatively, strongly associated family land ownership with the cultural value of tukufakaholo. As a result, they saw their familial lands as a treasure, secured and passed on by ancestors, which should be cherished. This viewpoint is linked to previous research in Ha‘apai stating:

> For the people of Ha‘apai, “biodiversity” is not just a matter of scientific, economic (in monetary terms), recreational or ecological value. It is a capital inheritance that has been passed on, relatively intact or in some cases enhanced, by past generations to current generations. Biodiversity is not income to be spent or destroyed. (Thaman et. al., 1996 as cited in Tonga Department of Environment, 2004, p. 3)

That Thaman (2009) is correct, and education is indeed “worthwhile learning” (p. 1), I feel more research is needed to engage diverse Pacific communities in determining how their epistemologies and ontologies can best be (ethically) incorporated to enhance teaching and learning about local (Pacific) ecologies, flora and fauna. Through my exploration of local, national and international literature, and after considering participants repeatedly discussing their senses of feeling connected to a place, I would suggest that further research be carried out on the potential for place-concious pedagogies in the two case study sites – especially when considering the teachers’ concerns to have alternatives to passive learning from written notes and students’ concerns for climate effects.

In this era of climate change, place-based science education provides students with a means of carrying out inquiry which gives them a holistic understanding of the impacts of climatic factors in an ecosystem. As Coker (2017), below suggests:

> There is another reason why scientists must balance place-based and non-place-based ways of thinking: to see both the proverbial forest and the trees. Place-based investigations are necessary to see how systems operate as a whole. Such studies tend to be contextualised, messy, multivariate endeavours with a more practical purpose. (p. 72)

However, conventional Place-Based Education has been critiqued for neglecting to meaningfully engage with Indigenous forms of knowledge and for colonial oppression (Twance, 2019). Further research is needed on how Place-Based Education could be used to explore the environmental issues, including climate change impacts, in Ha‘apai and Port Vila beyond the walls of the classroom, in partnership with communities.

Theme Two: Indigenous Languages as gateways to learning

Throughout our talanoa, I found that the land and seascape were presented by Year 10 Port Vila and Ha‘apai science students as “storied places” (McBryde, 2000, p. 169). It also struck me that the ability to speak Indigenous languages provides students in numerous Pacific

communities with a means of understanding traditional knowledge and skills in settings which are transmitted through those specific languages belonging to the places within which that TEK is embedded. As discussed elsewhere in this thesis (see chapters 7 and 9), the colonial legacy is reflected strongly through Vanuatu schooling as "the principal languages of education are French and English" (Vanuatu Ministry of Education, 2010, p. 2). Given the priviledged status of English in science education instruction and assessments in both of the case study sites, it was evident that Indigenous languages were marginalised.

The transmitting of TEK to the younger generation is done through family and village contexts. This is particularly important for science educators in Vanuatu to consider, given that country's phenomenal cultural and linguistic diversity (François et al., 2015). Yet, the students I met at Future College in Port Vila (where English must 'always' be spoken, according to the school rules), were not confident in speaking their Indigenous/familial languages. However, they still highlighted stories shared with them by family elders, including stories of sea-level rise. These stories were presented in ways that suggested they were instrumental to their learning about local environments.

Ha'apai students also showed how TEK can be found in place names, as this knowledge is passed down the generations and, amongst other things, can provide a means of recognising changes in the environment. The Year 10 science students I met in Ha'apai were quite familiar with the traditional place narratives of Ha'apai and they consistently identified their elders and long-time residents of Ha'apai as the most significant sources of local environmental knowledge. In many respects, this finding reminded me of the work of Basso (1996) in his autoethnographic study amongst Western Apache elders.

Basso (1996) recorded, for example, that these elders would read the environment in much the same way as a historical text or photo: "like so many faithful photographs, he [an Apache elder] says, they record the look of the land as it was in ancestral times – and the look of the land was lush. It is less so today. Something must have happened" (p. 16). I am also now drawn to the work of Cajete (2020) who proposed that "all cultures have developed a form of science which is important to the overall diversity of human knowledge related to the biosphere" (p. 3).

My research findings suggest that we must also recognise how language (whether colonial, Indigenous or otherwise) is reflected within science education programmes and/or whether students experience a wide enough set of cultural contexts/perspectives when exploring scientific issues (Kim & Dopico, 2016). After reflecting carefully upon my own daily teaching experiences in Tonga, and my research in Ha'apai, it has become much more apparent

to me that the official curriculum privileges the English language when our (Tongan) TEK is encoded in our Indigenous (Tongan) language (Maffi, 2005).

I reflect on this with some sense of loss as, although I grew up in Tonga, my proficiency in Tongan language and culture is not where I hope it could be as English was the language spoken at home and at the schools I attended. For, I pause here to confess, perhaps to again talaloto (bear testimony) to my experience as a teacher-researcher of heterogenous cultural heritage:

Sharp words like Indigenous, western
Cut me both ways to see who is inside
I pick up the knife to dissect and slice
Ignoring the smell of my own fear
Of being found out, thrown out
As I am neither there, nor here

However, I believe regardless of anyone's starting point and reasons given to explain why this is so, it is key to support teachers to grow in their willingness and ability to engage with Indigenous languages and cultures. I believe this can be done through community involvement in the design and delivery of curriculum, as discussed elsewhere. This removes the pressure from teachers to be experts in TEK but rather could create an inclusive environment for both teachers and students, whatever their language abilities or cultural knowledge levels, to ako alongside each other.

To begin the long journey of engaging with Indigenous languages and cultures in our schooling is to heed the warning given by Skutnabb-Kangas (2013) that "subtractive dominant language medium education can already be seen – linguistically, psychologically, sociologically and educationally – as [linguistic] genocide" (p. 97). I therefore suspect it may be well worthwhile to conduct further research to explore whether monolingual English science classes in other Tongan and Vanuatu communities reinforce the belief that foreign languages and cultures are socioeconomically superior to Indigenous languages and cultures.

Many of the findings of this thesis, however, also point to the opportunities for culturally meaningful environmental learning that collaboration between schools and students' communities could present. In this collaboration with communities, including customary holders of TEK, proficiency in the languages of the community would be considered an asset rather than a hindrance to science learning. In summary, this study would suggest that Tongan and Vanuatu education administrators and teachers must reflect upon the hierarchisation that

results from a curriculum design process that ultimately places greater value upon the colonial language(s) of schooling rather than the Indigenous familial languages of the local community.

Theme Three: Marginalization of traditional ecological knowledge in science education

The framing of local environmental issues in science education in Port Vila and Ha'apai is strongly influenced by prescribed national curricula, which prioritise foreign concepts embedded within foreign (colonial) languages. These alien concepts are learned through reading and writing, rather than learning the ecological literacy that involves reading local land and seascapes as TEK texts. Despite this, teachers in both case studies still recognised the high level of TEK held by their students, particularly those from more remote/rural areas. They were also aware of the gap sitting between the prescribed (official) syllabus and students' lived experiences. As a result, this research would suggest that it would be helpful for future research to be done that may consider alternative forms of assessment which value Indigenous rather than colonial epistemologies, particularly considering the ecological degradation that Pacific societies are experiencing.

Research found that schooling has been considered as one of the main factors responsible for eroding the maintenance of TEK in Malekula, a community in Vanuatu (McCarter & Gavin, 2011). In Tonga, Palefau (2005) has similarly reported that many young people do not have adequate knowledge of traditional skills and knowledge beneficial to their communities. Yet, as stated earlier in this chapter (and elsewhere in chapters 5, 7 and 9), I met teachers of Year 10 science in both places who valued the TEK held by students – although this TEK was largely not included in summative assessments.

This finding reminded me of the Alaskan research of Barnhardt and Kawagley (2005), who also concluded that "the depth of Indigenous knowledge rooted in the long inhabitation of a place offers lessons that can benefit everyone, from educator to scientist, as we search for a more satisfying and sustainable way to live on this planet" (Barnhardt & Kawagley, 2005, p. 9). This underscores the value of TEK in response to the climate crisis and presents a form of Indigenous resistance to the onslaughts of consumerism and commodification by teaching alternative patterns of consumption and production (Bowers, 2002).

As Kimmerer (2013) also added, "Science itself, as the curiosity-driven pursuit of knowledge of the natural world, is a fundamental human activity which is not limited to the confines of the western worldview" (p. 56). Upon the completion of this thesis, I believe that it is vital that we, as Pacific peoples, recognise that science was on our shores long before the

advent of schooling, western medicine and foreign textbooks, as my elders remind me. I envisage a place-conscious approach to Pacific regional science education that first looks to local sources of knowledge before drawing upon those global (i.e., colonial/neocolonial) sources of knowledge, which are already prioritised in our assessments.

As a science teacher, I am now inclined to believe that my colleagues and I must seriously consider the link that does exist between changing local cultures and local environmental issues and our teaching. As Woodley (2010) advocates:

> Changing livelihoods, worldviews and value systems alter people's sense of place and cultural identity and lead to a breakdown in the intergenerational transmission of local knowledge, practices and languages that are so closely tied to the surrounding environment. In turn, this has a negative impact not only on cultures and cultural diversity, but also on biodiversity. (p. 133)

Theme Four: Contextualisation through dialogue

The students I met during the course of this research frequently mentioned dialogue as a means of learning about their cultures and environments. They often experienced dialogical pedagogies when learning about places, flora and fauna – from family members – outdoors at the place/s concerned. Despite the time constraints of the official (exam-driven) curriculum of both countries, the science teachers I met in Port Vila and Ha'apai still attempted to contextualise prescribed syllabus content through dialogue with students. In this dialogue teachers trusted students to share 'genuine' learning experiences in places of cultural significance to them, such as their home islands or the ocean, to adopt a more student-centered approach to classroom teaching and learning.

It should be noted that the teacher participants themselves, in both case study sites, realised the value of active, experiential and place-conscious learning. They consistently advised me they preferred this, and believed their students would as well, rather than the more conventional/colonial 'chalk and board' (i.e. behaviourist) approach to teaching science. However, similar to Lumelume (2007) findings in Vanuatu, I also found that these indoor conventional methods of teaching science are maintained by an emphasis on success through written examinations (in a non-Indigenous language). Dialogue with students, albeit largely confined to classrooms, seemed to best enable these teachers to make science curriculum content relevant to local issues. Yet, they still had to mediate the time pressures they felt, not too dissimilar in scope to the tyranny of time described by teachers elsewhere (see for example, Manning, 2009).

Ha'apai teachers also emphasised their joy of learning alongside students through practical learning activities. However, dialogue about TEK also provided opportunity for teachers to learn alongside students in both case studies. This is related to the claim of Freire (1970/2005) that:

> Through dialogue, the teacher-of-the-students and the students-of-the-teacher cease to exist and a new term emerges: teacher-student with students-teachers. The teacher is no longer merely the-one-who-teaches, but one who is himself taught in dialogue with the students, who in turn while being taught also teach. They become jointly responsible for a process in which all grow. (p. 80)

Following Freire's (1970/2005) argument, a classroom with narration by the teacher (rather than dialogue), may prevent students from critically thinking about forces which may drive the changes they see in their communities culturally and ecologically amidst this climate crisis.

Many Pacific communities have an Indigenous "dialogical form of engagement" (Sanga et al., 2020, p.2) such as tok stori shared by Solomon Islands, Vanuatu and Papua New Guinea, or forms of talanoa in Tonga, Samoa and Fiji (Sanga et al., 2020) or storian specific to Vanuatu (Warrick, 2009). These oral methods of knowledge transmission are grounded in relationships, recognizing that knowledge is rooted in people and their places. Consequently, I found it interesting that the Port Vila teachers I met had noted the 'breakdown' of knowledge that occurs in the intergenerational transfer of TEK, especially once families have moved to an urban area like Port Vila, similar to the findings of Kraemer (2013).

Given that this research suggests that genuine dialogue may empower my teacher participants to take steps towards what Freire (1970/2005) has coined transformative action, I have been prompted to reconsider my own teaching practices. I believe that the key to me enabling dialogue with my own students will be the establishment of reciprocal trust similar to the concept of feveitokai'aki (mutual reciprocity) as discussed in Chapter 3. This respect and trust is not a uniquely Tongan aspect of knowledge-sharing relationships. Sanga et al. (2020) similarly presented tok stoi as a "habitual activity" (p. 5) of Pacific people from Vanuatu, Solomon Islands, PNG and elsewhere. It was also interesting to note how Sanga et al., (2020) described how this trust best arises: "in the tok stori process participants are positioned as experts in their own lives and their perspectives validated" (p. 4).

This has implications for the co-design of curricula dealing with local environmental issues between schools and their surrounding communities. The *Langa Fale Ako* framework, for example, holds potential because it has been developed for ongoing teacher education in Tonga and it assumes a "connection between school and communities and the relationships

that teachers and parents foster to support schooling" (Johansson-Fua, 2008, p. 4). When it comes to studying local environmental issues, my research has also found that dialogue between teachers and students can be expanded beyond the walls of the classrooms and into communities. This curriculum design approach would better allow for the co-design (involving teachers/community leaders/holders of TEK/family elders) to co-develop science inquiry activities to engage students with the local culture, communities and climate change issues of concern to all stakeholders.

It appears crucial, therefore, to begin to: (i) ground science education in the communities that the students live in and, (ii) ensure students/teachers (ethically) acquire some level of competency in TEK beneficial for sustainable living in their local communities and an act of resistance towards unsustainable lifestyles. This seems preferable to a curricula that is more aligned with foreign, monetarist values and distant metropolitan lifestyles (Thaman, 2001).

Lessons learned

My review of content taught in science classes (and how/why science is taught in two Pacific region case study sites), leads me to conclude that further research needs to be conducted. In Vanuatu, I would encourage further research be undertaken to explore how kastom could be interwoven with skul (schooling as introduced by Christian missionaries), given their traditional opposition (Bolton, 1999). Similarly, in Ha'apai, my research suggests that it would be beneficial to conduct some future studies to explore how Indigenous funds of ecological knowledge, such as talatukufakaholo (see Lātū, 2017), can be used to reinvigorate science education in Tonga – given these funds of traditional knowledge have long been undervalued by those with oversight of Tonga's schooling system (Koloto, 1998).

Research by Palefau (2005) has similarly suggested that learning traditional knowledge and skills could be incorporated into schooling through community apprenticeship programs in Tonga. I would subsequently be interested to see further research exploring the implementation of such programs – particularly if they are informed by input from local custodians of TEK in partnership with schools in Tonga and, similarly, in Vanuatu.

Place-Based Education has potential to foster community and inter-school collaboration for science learning, because it requires that the science curriculum must be contextualised by drawing upon the traditional epistemologies and ontologies of the communities the school/s serve – rather than the personal interests of the teacher/s. I would, therefore, like to see further research conducted to examine how Indigenous concepts of place

can be employed to support the development of a critical/Indigenous place-conscious curriculum, especially one that considers the potential tensions associated with the intertwining of Christian religious and Indigenous knowledge systems, so meaningful to many people of the Pacific (Puamau, 2004, p.33).

Recognition of the inherent value of Indigenous science or TEK may, for example, shift educators' deficit view of local communities as being in need of 'education' to one where the community is a valid source of knowledge (thus worth collaborating with). My research suggests that this sort of place-conscious/community-based approach to science education would necessitate "learning and research at the interface" of western and Indigenous science (Durie, 2004).

My research findings (see Chapter 9) also tend to suggest the need for consideration of pragmatic changes to science education in Ha'apai and Port Vila to ensure Year 10 students can share their rich lived experiences and contribute their TEK (embedded in kastom) to whole class learning. The teachers I met dually recognised that their students' proficiency in non-English languages enabled them to engage with their environment in culturally grounded ways, while their struggles with the English language hindered them from achieving success in written summative assessments – which had to be completed in English. As a result of this finding, I would strongly urge other science teachers and educational administrators/school leaders in both countries – to critique the wisdom of privileging of colonial languages over Indigenous understandings of the environment and climate change in the design, delivery and assessment of the official science curriculum.

As Hough and Skutnabb-Kangas (2005) have earlier proposed, I would reason that "the most decisive educational factor in causing negative statistics of Indigenous 'performance' [in Science Education] is the use of the wrong teaching language (together with lack of Indigenous content, methods and ethos in schools)" (p 107). In a similar vein, Taufe'ulungaki (1999) has stressed that if schools continue to neglect the Indigenous languages/knowledge of their local Pacific communities, we would essentially be deciding to let Pacific languages "die, together with their associated cultures" (p. 4). This is, consequently, not only a problem for language teachers to grapple with but also science teachers.

As a result, I would like to see further research undertaken to explore the opportunities that may exist when a science education curriculum enables students (and teachers) to draw upon their local languages to learn or teach science in Pacific communities. Given my own research findings, I strongly suspect Ha'apai and Port Vila students may well benefit from being positioned to conduct authentic research (i.e., inquiry) tasks in their communities on

issues such as: (i) waste disposal, (ii) changing agricultural and fishing practices, (iii) their families' experiences of preparedness for cyclones and sea level rise, (iv) growth and use of traditional medicinal plants or, (v) any other 'special topic' matters of particular interest to individual students and/or the school's local community members.

The findings of student inquiry projects, if well designed, could prove useful for community planning – such as is the case with management of Special Marine Areas in Tonga, or support government departments' research in ways that align with global citizen science initiatives (Bonney et al., 2009; Cronin et al., 2004) initiatives. Multilingual students of science, moreover, can conduct scientific inquiries that access those diverse pools of knowledge urgently needed for the development of EbA strategies in response to climate change (see Chapter 8). A challenge for student involvement in developing EbA strategies will, however, inevitably require a critique of historical and contemporary power relations between the streams of western and Indigenous sciences in the Pacific region (Nalau et al., 2018).

Therefore, further research is also required, therefore, to determine how schools in Ha'apai and Port Vila could ethically engage with holders of TEK for the purposes of contributing towards their communities' adaptation responses to climate change. However, researchers require the awareness that the relationship between Indigenous and 'western' science has all too often been "asymmetrical, unequal, shaped not so much by people's sense of being and love of knowledge, but by market forces" (Ratuva, 2009, p. 161). It was interesting, for example, to find that the Year 10 students I spoke to in Ha'apai and Port Vila did not link changes they observed around them with climate change, but saw local actions as the causes of environmental degradation.

Hence, I would conclude that it is vital that any future revised science curriculum presented to these students can draw links between their local communities and global environmental trends. The students I have met need to be supported to see environmental concepts at work in their community. They also need to be enabled to use their community language to share their growing knowledge of these science concepts in equitable assessment activities. They also need a curriculum that will support them to gain credentials whilst actively demonstrating their ability to support their communities' efforts to become more resilient to the numerous scientific challenges posed by climate change.

I suspect further research is also needed to explore how place-conscious, inquiry-based learning activities – involving youth as community researchers – could challenge cultural norms and positioning, which may otherwise hinder them speaking out about their environmental concerns. The research of Havea (2020) has shown that community members

(such as parents) in Ha‘apai can come to schools to learn about climate change from students, and it would be interesting to conduct further research that involves students moving beyond their school compounds to examine how they can best work in partnership with local communities to collectively respond to concerns such as coastal erosion – while also enhancing their learning of science.

It also became apparent to me – from my conversations with students and teachers – that schools in Port Vila would benefit from increased community engagement in the design, delivery, assessment and evaluation of Vanuatu science curriculum procedures. The Port Vila teachers I met – like their peers in Ha‘apai – often originated from elsewhere in the country. As a result, their students often played an important role in contextualising learning about environmental science. I would therefore conclude that more thought should be given to the development of community partnerships which enable teachers to critically understand “the cultural ecology of their students” (Bowers, 2005, p.35). This strategy may better enable science teachers to connect with local holders of TEK to form closer bonds and become more place-conscious in their design of teaching activities.

Contribution to knowledge

Increasingly, research in the Pacific region has looked to the connections between Indigenous knowledge and ‘western’ science to explore community engagement with traditional and contemporary weather and climate forecasting (Chambers et al., 2019; Lefale, 2010). Other climate science research has, in turn, explored: (a) how changes in culture impact traditional marine resource management (Hickey, 2006; Bender, 2002); (b) influence legal protection bio-cultural heritage (Techera, 2012) and; (c) impact traditional knowledge of Pacific communities (Ratuva, 2009). Through a series of talanoa in Tonga and Vanuatu, this research has contributed to the international literature by exploring how Year 10 students and their science teachers currently experience the interface (see Durie, 2004) that exists between Indigenous knowledge or TEK, and western science.

Furthermore, this research has highlighted the tensions that sit at this interface. These tensions are also commonly found in other schooling contexts around the Pacific, which still reflect the legacy of colonial structures of schooling. These legacies of colonisation include rigid timetables, which place teachers under significant time pressure (Manning, 2009), and the continuance of a standardised curriculum and affiliated high-stakes testing in secondary schooling (Lumelume, 2007; ‘Otunuku et al., 2017). Of further concern is evidence of a trend

in which teachers of science have displayed unfamiliarity with the places they teach in (Manning et al., 2020).

This research has also highlighted opportunities for further research explorations on how science teachers can best take advantage of opportunities to partner with their students' communities to co-design place-conscious/culturally grounded science curricula activities.

Havea (2020), for example, has explored youth perceptions of climate change in Ha'apai by using talanoa and has designed a culturally responsive teaching intervention for climate change education. As an outcome of her research, Havea (2020) has suggested that climate change education curriculum should be developed based on teacher and students' perceptions of climate change, in order to build on this knowledge, addressing any misconceptions. The findings of this research, however, suggests that Indigenous/traditional knowledge of the environment is currently marginalised by schooling and curricula design procedures. My research would suggest that a culturally grounded science education curriculum requires nothing less than a meaningful partnership with the students' communities. This partnerships must recognise the value of the traditional knowledge these communities continue to pass down, despite the historical disruptions caused by the introduction of western models of schooling.

If education in Pacific communities is to meaningfully disrupt the uncritical acceptance of western consumerist lifestyles (which commodify knowledge), I would conclude that it must empower students to critically "examine the ecological footprint of the non-commodified activities, forms of knowledge and skills acquired through mentoring relationships – as well as learning to participate in these aspects of community life" (Bowers, 2002, p. 13). This proposition aligns nicely with the work of Palefau (2005), who proposed that traditional knowledge and skills be learnt by students via an apprenticeship approach with TEK holders in the community.

Such an approach must also strive to ensure that curriculum design dialogue first takes place with those communities sitting beyond the classroom walls. As Freire (1970/2005), also advised:

> Dialogue cannot exist, however, in the absence of a profound love for the world and for people … On the other hand, dialogue cannot exist without humility … How can I dialogue if I always project ignorance onto others and never perceive my own?... How can I dialogue if I am closed to – and even offended by – the contribution of others? How can I dialogue if I am afraid of being displaced, the mere possibility causing me torment and weakness? Self-sufficiency is incompatible with dialogue. (pp. 89 - 90)

As a Tongan teacher-researcher I believe the concepts of ako (reciprocal learning) and feveitokai‘aki (reciprocal respect and honouring) would be essential values to guide any attempt in my country to rethink the relationships between teachers and students, schools and communities which underpin the teaching and learning of science. Given Freire’s comments above, in relation to the role of Christianity within Tongan society (Tapa‘atoutai-Teisina, 2020), I also recall the challenge offered by Tatafu et al. (1997). I believe this is relevant for my fellow Pacific teachers when we may consider the hardships of stepping outside the walls of our classrooms to engage in this dialogue:

> *ka 'oku kalisitiane mo'oni pe 'a e 'ofa 'ia, pea 'oku 'ikai ke toe ai ha me'a ia 'e toe faingata'a*
>
> If love is genuinely Christian, then nothing is difficult (Tatafu et al., 1997, p. 72).

Concluding proverb

During the course of this research, I have constantly been guided by the proverb that opened this thesis, which I interpreted as a metaphor for valuing Pacific regionalism. It stated: “*Pikipiki hama kae vaevae manava*”, which tells of the act of bringing together, joining or linking the *hama* [outriggers] of the canoes in order to enable the sharing or distribution of the *manava* (food)” (‘Ahio, 2011, p. 72). To close this thesis, I will now offer another proverb, for contemplation, when reflecting on the messages to arise from the various talanoa central to this doctoral research. This concluding proverb states:

Tākanga ‘enau fohe

This proverb is translated as “Their oars are mates” (Free Weslyan Church of Tonga Education Office, 2007, p. 24) and it speaks of people working together to successfully complete their responsibilities. It speaks to the collaboration which is necessary between schools and communities, science educators and TEK custodians to address the challenges posed by climate and cultural change. We need to work together to pursue restorative rather than destructive ways of being in our shared world, especially in light of the global challenges of the climate crisis we collectively face.

References

‘Ahio, L. L. (2011). *Vaevae Manava: context and perception of food security for Tongan mothers and health workers* [Master's thesis, Auckland University of Technology]. Tuwhera Open Thesis and Dissertations. http://hdl.handle.net/10292/3487

‘Otunuku, M., Fa‘avae, D., Toumu'a, R., & Robyns, R. (2017). *Culture of testing: Kingdom of Tonga* [Report]. United Nations Educational Scientific and Cultural Organization & University of the South Pacific (Tonga). http://repository.usp.ac.fj/11305/1/2017_Culture_of_Testing_Case_Study_in_Tonga_FINAL_REPORT_OTUNUKU_ET_AL_v3.pdf

Adams, J. D. (2010). One hundred ways to use a coconut. In D. J. Tippins, M. P. Mueller, M. van Eijck, & J. D. Adams (Eds.), *Cultural Studies and Environmentalism* (Vol. 3, pp. 331-335). Springer. https://doi.org/10.1007/978-90-481-3929-3_28

Adams, T. E., Ellis, C., & Jones, S. H. (2017). Autoethnography. In J. Matthes, C. S. Davis, & R. F. Potter (Eds.), *The international encyclopedia of communication research methods* (Vol. 1, pp. 11). John Wiley & Sons. https://doi.org/10.1002/9781118901731.iecrm0011

Aikenhead, G. S. (1996). Science education: Border crossing into the subculture of science *Studies in Science Education*, *27*(1), 1-52. https://doi.org/10.1080/03057269608560077

Andrade Pérez, A., Herrera Fernández, B., & Cazzolla Gatti, R. (2010). Introduction. In A. A. Pérez, B. H. Fernández, & R. C. Gatti (Eds.), *Building resilience to climate change: Ecosystem-based adaption and lessons from the field* (pp. 11-19). International Union for Conservation of Nature. https://www.iucn.org/content/building-resilience-climate-change-ecosystem-based-adaptation-and-lessons-field-0

Anglican Church in Aotearoa, New Zealand and Polynesia. (1989/2021). *A New Zealand prayer book: He Karakia Mihinare o Aotearoa*. https://anglicanprayerbook.nz/404.html

Aporosa, S. A. (2019). De-mythologizing and re-branding of kava as the new ‘world drug’ of choice. *Drug Science, Policy and Law*, *5*, 1-13. https://doi.org/10.1177/2050324519876131

Baba, T. L. (1985). Education in the Pacific Islands. In R. C. Kiste & R. A. Herr (Eds.), *In the Pacific Islands in the year 2000*. Pacific Islands Studies Program, Center for Asian and Pacific Studies, University of Hawai'i at Manoa. http://hdl.handle.net/10125/15521

Banfield, A. (2017). When ‘Acts of God’ strike: Faith responses and leadership in natural disasters in Vanuatu. *Asia Pacific Humanitarian Leadership Conference Proceedings*, 65-69, Article Paper 16. https://ojs.deakin.edu.au/index.php/aphl/article/view/824

Barnhardt, R. (2007). Creating a place for indigenous knowledge in education: The Alaska native knowledge network. In D. A. Gruenewald & G. A. Smith (Eds.), *Place-based education in the global age: Local diversity* (1st ed., pp. 113-133). Taylor and Francis Group. https://doi.org/10.4324/9781315769844

Barnhardt, R., & Oscar Kawagley, A. (2005). Indigenous knowledge systems and Alaska Native ways of knowing. *Anthropology & Education Quarterly*, *36*(1), 8-23. https://doi.org/10.1525/aeq.2005.36.1.008

Basso, K. H. (1996). *Wisdom sits in places: Landscape and language among the Western Apache*. University of New Mexico Press. https://unmpress.com/books/wisdom-sits-places/9780826317247

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, *13*(4), 544-559. https://doi.org/10.46743/2160-3715/2008.1573

Bay, J. L., Fohoko, F., La'Akulu, M., Leota, O., Pulotu, L., Tu'ipuloto, S., Tutoe, S., Tovo, 'O., Vekoso, 'A., & Pouvalu, 'E. H. (2016). Questioning in Tongan science classrooms: A pilot study to identify current practice, barriers and facilitators. *Asia-Pacific Forum on Science Learning and Teaching*, *17*(2), Article 10. https://www.eduhk.hk/apfslt/

Beals, F., Kidman, J., & Funaki, H. (2020). Insider and outsider research: Negotiating self at the edge of the emic/etic divide. *Qualitative Inquiry*, *26*(6), 593-601. https://doi.org/10.1177/1077800419843950

Bender, A. (2002). Environmental models, cultural values, and emotions: Implications for marine resource use in Tonga. *International Research in Geographical and Environmental Education*, *11*(1), 58-62. https://doi.org/10.1080/10382040208667465

Bender, A. (2009). Meshing a tight net: A cultural response to the threat of open access fishing grounds. In M. J. Casimir (Ed.), *Culture and the changing environment* (1 ed., pp. 197-218). Berghahn Books. http://www.jstor.org/stable/j.ctt9qd417.12

Beumelburg, P. D. (2016). *Apiianga no te oraanga akapuapinga e te taporoporo i te ipukarea: Education as sustainable development: Mangaia, Cook Islands* [Doctoral dissertation, Massey University]. Massey Research Online. http://hdl.handle.net/10179/10034

Bogdan, R., & Biklen, S. K. (2007). *Qualitative research for education: An introduction to theory and methods* (5th ed.). Allyn & Bacon. https://www.pearson.com/us/higher-education/program/Bogdan-Qualitative-Research-for-Education-An-Introduction-to-Theories-and-Methods-5th-Edition/PGM125872.html?tab=overview

Bolton, L. (1999). Radio and the redefinition of Kastom in Vanuatu. *The Contemporary Pacific*, *11*(2), 335-360. http://www.jstor.org/stable/23717379

Bolton, L. (2003). *Unfolding the moon: Enacting women's kastom in Vanuatu*. University of Hawai'i Press. https://www.jstor.org/stable/j.ctt6wr2jk

Bonney, R., Cooper, C. B., Dickinson, J., Kelling, S., Phillips, T., Rosenberg, K. V., & Shirk, J. (2009). Citizen Science: A Developing Tool for Expanding Science Knowledge and Scientific Literacy. *BioScience*, *59*(11), 977-984. https://doi.org/10.1525/bio.2009.59.11.9

Bourdieu, P. (2002). The forms of capital. In N. W. Biggart (Ed.), *Readings in economic sociology* (pp. 280-291). John Wiley & Sons. https://doi.org/10.1002/9780470755679

Bowers, C. A. (2001). How language limits our understanding of environmental education. *Environmental Education Research*, *7*(2), 141-151. https://doi.org/10.1080/13504620120043144

Bowers, C. A. (2002). Toward an eco-justice pedagogy. *Environmental Education Research*, *8*(1), 21-34. https://doi.org/10.1080/13504620120109628

Bowers, C. A. (2005). *The false promises of constructivist theories of learning: A global and ecological critique*. Peter Lang Publishing. https://www.peterlang.com/view/title/58521

Boyer, P. (2006). *Building community: Reforming math and science education in rural schools*. Alaska Native Knowledge Network. http://ankn.uaf.edu/Publications/building_community.pdf

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Bray, M. (1992). *Educational planning in small countries*. United Nations Educational, Scientific and Cultural Organization.

https://web.edu.hku.hk/f/acadstaff/376/Educational%20Planning%20in%20Small%20Countries.pdf
Bray, M. (1998). Regional examinations councils and geopolitical change: commonality, diversity, and lessons from experience. *International Journal of Educational Development*, *18*(6), 473-486. https://doi.org/10.1016/S0738-0593(98)00024-8
Brayboy, B. M. J., & Bang, M. (2019). Societal issues facing Indigenous education: Introduction. In E. A. McKinley & L. T. Smith (Eds.), *Handbook of Indigenous Education* (pp. 567-574). Springer Singapore. https://doi.org/10.1007/978-981-10-3899-0_76
Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, *18*(1), 32-42. https://doi.org/10.2307/1176008
Bündnis Entwicklung Hilft. (2020). *The WorldRiskReport*. http://www.worldriskreport.org/
Burnett, G. (2007). "Culture isn't what it used to be": Problematizing pedagogies of cultural difference in Pacific education. *Social and Economic Studies*, *56*(1/2), 261-276. http://www.jstor.org/stable/27866503
Cajete, G. A. (2020). Indigenous science, climate change, and Indigenous community building: A framework of foundational perspectives for Indigenous community resilience and revitalization. *Sustainability*, *12*(22), 9569. https://doi.org/10.3390/su12229569
Cajete, G. A., & Pueblo, S. C. (2010). Contemporary Indigenous education: A nature-centered American Indian philosophy for a 21st century world. *Futures*, *42*(10), 1126-1132. https://doi.org/10.1016/j.futures.2010.08.013
Cakmakci, G., Aydeniz, M., Brown, A., & Makokha, J. M. (2020). Situated cognition and cognitive apprenticeship learning. In B. Akpan & T. J. Kennedy (Eds.), *Science education in theory and practice: An introductory guide to learning theory* (pp. 293-310). Springer International Publishing. https://doi.org/10.1007/978-3-030-43620-9_20
Calderon, D. (2014). Speaking back to manifest destinies: a land education-based approach to critical curriculum inquiry. *Environmental Education Research*, *20*(1), 24-36. https://doi.org/10.1080/13504622.2013.865114
Catherwood, V., Levine, V., & Tonga Ministry of Education Planning Group. (2004). *Tonga education policy framework 2004-2019*. Tonga Ministry of Education. http://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/tonga_final-draft_policy_framework_2004-2019.pdf
Catherwood, V., Taufa, T., Scott, C., & Cook, B. (2003). *Tonga - education sector report*. Government of Tonga & New Zealand Agency for International Development. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.456.9067&rep=rep1&type=pdf
Cave, J., & Koloto, 'A. H. (2015). Short-term visits and Tongan livelihoods: Enterprise and transnational exchange. *Population, Space and Place*, *21*(7), 669-688. https://doi.org/10.1002/psp.1920
Ceccarelli, D., Wendt, H., Matoto, A., Fonua, E., & Fernandes, L. (2017). *Biophysically special, unique marine areas of Tonga*. Marine and Costal Biodiversity Management in Pacific Island Countries (Deutsche Gesellschaft für Internationale Zusammenarbeit, International Union for Conservation of Nature & Secretariat of the Pacific Regional Environment Programme). http://macbio-pacific.info/Resources/biophysically-special-unique-marine-areas-of-tonga/
Chambers, L., Lui, S., Plotz, R., Hiriasia, D., Malsale, P., Pulehetoa-Mitiepo, R., Natapei, M., Sanau, N., Waiwai, M., Tahani, L., Willy, A., Finaulahi, S., Loloa, F., & Fa'anunu, O. (2019). Traditional or contemporary weather and climate forecasts: reaching Pacific

communities. *Regional Environmental Change*, *19*(5), 1521-1528. https://doi.org/10.1007/s10113-019-01487-7
Chang, H. (2016). *Autoethnography as method* (1st ed.). Routledge. https://www.routledge.com/Autoethnography-as-Method/Chang/p/book/9781598741230 (Original work published 2008)
Chang, H., Ngunjiri, F., & Hernandez, K.-A. C. (2013). *Developing qualitative inquiry: Collaborative autoethnography*. Left Coast Press. https://doi.org/10.4324/9781315432137
Churchward, C. M. (1959). *Tongan dictionary* (Special limited ed.) [In commemoration of the 60th birthday of His Majesty King Tupou VI]. Tonga Fast Print.
Cobern, W. W. (1991). *World view theory and science education research*. ScholarWorks at WMU. https://scholarworks.wmich.edu/science_slcsp/44
Cobern, W. W. (1996). Worldview theory and conceptual change in science education. *Science education*, *80*(5), 579-610. https://doi.org/10.1002/(SICI)1098-237X(199609)80:5<579::AID-SCE5>3.0.CO;2-8
Cohen, L., Manion, L., & Morrison, K. (2017). *Research methods in education* (8th ed.). Taylor & Francis Group. https://doi.org/10.4324/9781315456539
Coker, J. S. (2017). Pedagogy and place in science education. In D. Shannon & J. Galle (Eds.), *Interdisciplinary approaches to pedagogy and place-based education: From abstract to the quotidian* (pp. 71-83). Springer International Publishing. https://doi.org/10.1007/978-3-319-50621-0_6
Collins, M., An, S.-I., Cai, W., Ganachaud, A., Guilyardi, E., Jin, F.-F., Jochum, M., Lengaigne, M., Power, S., Timmermann, A., Vecchi, G., & Wittenberg, A. (2010). The impact of global warming on the tropical Pacific Ocean and El Niño. *Nature Geoscience*, *3*(6), 391-397. https://doi.org/10.1038/ngeo868
Connell, J. (2006). 'I can't eat that, it's purple': A geography field course in Vanuatu and Fiji. *Geographical Research*, *44*(1), 17-27. https://doi.org/10.1111/j.1745-5871.2006.00357.x
Cooper, J. M., & Alvarado, A. (2006). *Preparation, recruitment, and retention of teachers*. International Institute for Educational Planning http://iaoed.org/downloads/5_Cooper_web_151206.pdf
Corbin, J. M., & Strauss, A. L. (2008). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (3rd ed.). Sage Publications. https://doi.org/10.4135/9781452230153
Council of Pacific Arts and Culture, & Secretariat of the Pacific Community. (2010). *Pacific culture and education strategy 2010–2015*. Secretariat of the Pacific Community. https://www.spc.int/DigitalLibrary/Doc/HDP/Culture/Pacific_Culture_and__Education_Strategy_20102015.pdf
Cox, J., Finau, G., Kant, R., Tarai, J., & Titifanue, J. (2018). Disaster, divine judgment, and original sin: Christian interpretations of tropical cyclone Winston and climate change in Fiji. *The Contemporary Pacific*, *30*(2), 380-410. https://doi.org/10.1353/cp.2018.0032
Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Pearson Education (US). https://www.pearson.com/us/higher-education/product/Creswell-Educational-Research-Planning-Conducting-and-Evaluating-Quantitative-and-Qualitative-Research-Plus-My-Lab-Education-with-Pearson-e-Text-Access-Card-Package-4th-Edition/9780133018080.html?tab=overview
Croft, K. D., & Tu'ipulotu, P. (1980). A survey of Tongan medicinal plants. *South Pacific Journal of Natural Science*, *1*, 130-142.

http://www.uspaquatic.library.usp.ac.fj/gsdl/collect/spjnas/index/assoc/HASHdb61.dir/doc.pdf
Cronin, S. J., Gaylord, D. R., Charley, D., Alloway, B. V., Wallez, S., & Esau, J. W. (2004). Participatory methods of incorporating scientific with traditional knowledge for volcanic hazard management on Ambae Island, Vanuatu. *Bulletin of Volcanology*, *66*(7), 652-668. https://doi.org/10.1007/s00445-004-0347-9
Cummins, H. G. (Ed.). (1972). *Sources of Tongan history: A collection of documents, extracts and contemporary opinions in Tongan political history 1616-1900.*
Cutter-Mackenzie, A., & Smith, R. (2003). Ecological literacy: the 'missing paradigm' in environmental education (part one). *Environmental Education Research*, *9*(4), 497-524. https://doi.org/10.1080/1350462032000126131
Day, J., & Bamforth, T. (2020). This is our garden now. In D. Sanderson & L. Bruce (Eds.), *Urbanisation at risk in the Pacife and Asia* (1st ed., pp. 107-120). Routledge. https://doi.org/10.4324/9780429290176
DeBlock, H. (2018). Cannibals in paradise: The exotic, the familiar, and the strange in ritual and performance in Vanuatu *Journal of Anthropological Research, 74*(4), 541-557. https://doi.org/10.1086/699944
Demssie, Y. N., Biemans, H. J. A., Wesselink, R., & Mulder, M. (2020). Combining indigenous knowledge and modern education to foster sustainability competencies: Towards a set of learning design principles. *Sustainability*, *12*(17), 1-20, Article 6823. https://doi.org/10.3390/su12176823
Denzin, N. K., & Lincoln, Y. S. (2008). Introduction: The discipline and practice of qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *The landscape of qualitative research* (3rd ed., pp. 1-44). Sage Publications, Inc.
Department of Environmental Protection and Conservation of the Government of Vanuatu. (2011). *Republic of Vanuatu: Port Vila Urban Development Project*. Government of Vanuatu. https://www.adb.org/sites/default/files/linked-documents/42391-013-van-ieeab.pdf
Dornan, M., & Cain, T. N. (2015, July). Vanuatu and Cyclone Pam: An update on fiscal, economic, and development impacts. *Pacific Economic Monitor*, 23-27. https://www.adb.org/publications/pacific-economic-monitor-july-2015
Durie, M. (2004, March 11). *Exploring the interface between science and indigenous knowledge* [Conference presentation]. 5th APEC Research and Development Leaders Forum: Capturing value from science, Christchurch, New Zealand. https://www.massey.ac.nz/massey/fms/Te%20Mata%20O%20Te%20Tau/Publications%20-%20Mason/M%20Durie%20Exploring%20the%20interface%20Between%20Science%20and%20Indigenous%20knowledge.pdf?03556A425A28D3A9CBC47B5AB06D9658
Educational Research Human Ethics Committee. (2009). *Educational Research Human Ethics Committee: Principles and Guidelines*. University of Canterbury.
Engeström, Y. (2009). Expansive learning: Toward an activity-theoretical reconceptualization. In K. Illeris (Ed.), *Contemporary theories of learning: Learning theorists ... in their own words* (pp. 53-73). Routledge. https://doi.org/10.4324/9781315147277
Fa'anunu, J. (2017). *Adaptation to water scarcity in the context of climate change: A case study of the Nuku'alofa and Hihifo Districts, Tongatapu* [Master's thesis, University of Waikato]. Research Commons. https://hdl.handle.net/10289/11328

Fa‘avae, D. (2018). Foki kihe tupu‘anga: Talaloto and autoethnographic reflections of navigation back to the homeland. *Departures in Critical Qualitative Research*, *7*(4), 78-86. https://doi.org/10.1525/dcqr.2018.7.4.78

Fa‘avae, D. (2019). Tatala‘ae koloa‘oe to‘utangata Tonga i Aotearoa mo Tonga: a way to disrupt and decolonise doctoral research. *MAI Journal, 8*(1), 3-15. https://doi.org/10.20507/MAIJournal.2019.8.1.1

Fa‘avae, D., Jones, A., & Manu‘atu, L. (2016). Talanoa‘i ‘a e talanoa - talking about talanoa: Some dilemmas of a novice researcher. *AlterNative: An International Journal of Indigenous Peoples*, *12*(2), 138-150. https://doi.org/10.20507/AlterNative.2016.12.2.3

Fair, H. (2018). Three stories of Noah: Navigating religious climate change narratives in the Pacific Island region. *Geo: Geography and Environment*, *5*(2), 1-15, Article e00068. https://doi.org/10.1002/geo2.68

Fair, H. (2019). From apathy to agency: Exploring religious responses to climate change in the Pacific Island region. In C. Klöck & M. Fink (Eds.), *Dealing with climate change on small islands: Towards effective and sustainable adaptation?* (pp. 175-194). Göttingen University Press. https://doi.org/10.17875/gup2019-1208

Faka‘osi, S. L. (1993). *Land tenure system: changes and constraints in Tongan society* [Master's thesis, Australian National University]. Open Access Theses. http://hdl.handle.net/1885/122887

Fa‘oliu-Havea, P., Fa‘avae, D., Fusitu‘a, L., Folaumahina, ‘A., Lātū, D., & Feao, ‘E. (2018). *Tonga history teachers association (THTA) 2018 conference* [Professional and technical reports]. http://repository.usp.ac.fj/11308/

Fasi, ‘U. (2005). The role of assessment in educational planning. In P. Puamau & G. R. Teasdale (Eds.), *Educational planning in the Pacific: Principles and guidelines* (pp. 99-109). University of the South Pacific (Fiji). https://www.usp.ac.fj/index.php?id=2240

Faupula, A. M. (n.d.). *Mafoa e ata ‘i Tonga: Dawn of the light in Tonga* [Unpublished manuscript].

Fauville, G., Lantz-Andersson, A., & Säljö, R. (2014). ICT tools in environmental education: reviewing two newcomers to schools. *Environmental Education Research*, *20*(2), 248-283. https://doi.org/10.1080/13504622.2013.775220

Fehoko, E. S. (2014). *Pukepuke Fonua: an exploratory study on the faikava as an identity marker for New Zealand-born Tongan males in Auckland, New Zealand* [Master's thesis, Auckland University of Technology]. Tuwhera Open Thesis and Dissertations. http://hdl.handle.net/10292/7723

Fielakepa, T. K. T. (2014). Kupesi: A creative tradition of Tonga. In S. Lee (Ed.), *Traditional knowledge and wisdom: Themes from the Pacific Islands* (pp. 326-336). United Nations Educational, Scientific and Cultural Organization. https://www.unesco-ichcap.org/eng/contents/book_list_arc.php?mode=view&code=B0000586&page=8

Filous, A., Lennox, R. J., Beaury, J. P., Bagnis, H., McHugh, M., Friedlander, A. M., Clua, E. E. G., Cooke, S. J., Fuller, T. K., & Danylchuk, A. J. (2021). Fisheries science and marine education catalyze the renaissance of traditional management (rahui) to improve an artisanal fishery in French Polynesia. *Marine Policy*, *123*, 1-10, Article 104291. https://doi.org/10.1016/j.marpol.2020.104291

Fitzgerald, S. T. (2018). *Eco-identity: secondary science teachers’ experiences that cultivate place-based teaching in a Hawaiian cultural context* [Doctoral dissertation, University of Hawai‘i at Mānoa]. ScholarSpace. http://hdl.handle.net/10125/62356

Flexner, J. L. (2016). *An archaeology of early Christianity in Vanuatu: Kastom and religious change on Tanna and Erromango, 1839–1920*. ANU Press. https://doi.org/10.22459/TA44.12.2016

Food and Agriculture Organisation. (2014). *Tonga: Cyclone Ian in Ha'apai rapid damage assessment to the agriculture and fisheries sectors report*. United Nation Subregional Office of the Pacific Islands. https://reliefweb.int/sites/reliefweb.int/files/resources/Haapai%20Cyclone%20Ian%20Agriculture%20Damage%20Report%20Final%20Feb%2021%202013.pdf

Forsyth, M. (2009). *A bird that flies with two wings: Kastom and state justice systems in Vanuatu*. ANU Press. https://doi.org/10.22459/BFTW.09.2009

Fotu, K. F., Millar, L., Mavoa, H., Kremer, P., Moodie, M., Snowdon, W., Utter, J., Vivili, P., Schultz, J. T., Malakellis, M., McCabe, M. P., Roberts, G., & Swinburn, B. A. (2011). Outcome results for the Ma'alahi Youth Project, a Tongan community-based obesity prevention programme for adolescents. *The Pacific Obesity Prevention In Communities Project*, *12*(s2), 41-50. https://doi.org/10.1111/j.1467-789X.2011.00923.x

François, A., Franjieh, M., Lacrampe, S., & Schnell, S. (2015). The exceptional linguistic density of Vanuatu. In A. François, M. Franjieh, S. Lacrampe, & S. Schnell (Eds.), *The languages of Vanuatu: Unity and diversity* (pp. 1-22). Asia-Pacific Linguistics http://hdl.handle.net/1885/14819

Free Wesleyan Church of Tonga Education Office. (2007). *Ko e ngaahi palōvepi 'i he Lea Faka-Tonga'*. TongaPRINT.

Freire, P. (2005). *Pedagogy of the oppressed* (M. B. Ramos, Trans.; D. Macedo, Ed. 30th Anniversary ed.). The Continuum International Publishing Group. (Original work published 1970)

Gee, E. (2020, November 5). Fale Tonga training for cyclone preparedness. *Matangitonga Online*. https://matangitonga.to/2020/11/05/fale-tonga-training-cyclone-preparedness

Gillon, A. (2020). Growing the fleet; views of the Moana –A Māori re-search-teina's perspective on Māori and Pasifika re-search relationality. *MAI Journal*, *9*(1), 81-91. https://doi.org/10.20507/MAIJournal.2020.9.1.9

Gonzalez, N., Moll, L. C., Tenery, M. F., Rivera, A., Rendón, P., Gonzales, R., & Amanti, C. (2005a). Funds of knowledge for teaching in Latino households. In N. Gonzalez, L. C. Moll, & C. Amanti (Eds.), *Funds of knowledge : Theorizing practices in households, communities, and classrooms* (pp. 89-111). Taylor & Francis Group. https://www.taylorfrancis.com/chapters/introduction-theorizing-practices-norma-gonz%C3%A1lez-luis-moll-cathy-amanti/e/10.4324/9781410613462-5?context=ubx&refId=a572d739-4df8-465d-a05c-8bd1db8db800

Google. (n.d.-a). *[A map of selected islands of Vanuatu]*. Retrieved March 25, 2021 from https://www.google.com/maps/d/edit?mid=1ICDyJpBTJ_jAgPsWKgXs93pMAzEoRBIq&usp=sharing

Google. (n.d.-b). *[A map of the islands of Foa and Lifuka in Ha'apai (Kingdom of Tonga)]*. Retrieved March 25, 2021 from https://www.google.com/maps/d/u/0/edit?mid=1Z6SsXUTqCUGAUsTG0CWuQSweRBVssLfZ&usp=sharing

Google. (n.d.-c). *[A map showing the island group of Ha'apai in the Kingdom of Tonga]*. Retrieved March 25, 2021 from https://www.google.com/maps/d/u/0/edit?mid=1Z6SsXUTqCUGAUsTG0CWuQSweRBVssLfZ&usp=sharing

Google. (n.d.-d). *[Map of the island of Efate and neighbouring islands, located in Shefa Province in Vanuatu]*. Retrieved March 25, 2021 from https://www.google.com/maps/d/edit?mid=1ICDyJpBTJ_jAgPsWKgXs93pMAzEoRBIq&usp=sharing

Google. (n.d.-e). *[Map showing the location of Vanuatu and Tonga in the South Pacific Ocean]*. Retrieved March 25, 2021 from https://www.google.com/maps/d/u/0/edit?mid=1lFZcQ5ph-9LkagqFuaHsSkEFtbWp7kHe&usp=sharing

Granderson, A. A. (2017a). The role of traditional knowledge in building adaptive capacity for Climate Change: Perspectives from Vanuatu. *Weather, Climate, and Society*, *9*(3), 545-561. https://doi.org/10.1175/WCAS-D-16-0094.1

Granderson, A. A. (2017b). Value conflicts and the politics of risk: challenges in assessing climate change impacts and risk priorities in rural Vanuatu. *Climate and Development*, *10*(6), 481-494. https://doi.org/10.1080/17565529.2017.1318743

Griffin, P. J. (2020). Pacing Climate Precarity: Food, Care and Sovereignty in Iñupiaq Alaska. *Medical anthropology*, *39*(4), 333-347. https://doi.org/10.1080/01459740.2019.1643854

Gruenewald, D. A. (2003a). The best of both worlds: A critical pedagogy of place. *Educational Researcher*, *32*(4), 3-12. https://doi.org/10.3102/0013189X032004003

Gruenewald, D. A. (2003b). Foundations of place: A multidisciplinary framework for place-conscious education. *American Educational Research Journal*, *40*(3), 619-654. https://doi.org/10.3102/00028312040003619

Hadzigeorgiou, Y., & Skoumios, M. (2013). The development of environmental awareness through school science: Problems and possibilities. *International Journal of Environmental and Science Education*, *8*(3), 405-426. http://files.eric.ed.gov/fulltext/EJ1016851.pdf

Halapua, S. (2008). *Talanoa process: The case of Fiji*. East-West Centre.

Hancock, T. S., Friedrichsen, P. J., Kinslow, A. T., & Sadler, T. D. (2019). Selecting socio-scientific issues for teaching. *Science & education*, *28*(6), 639-667. https://doi.org/10.1007/s11191-019-00065-x

Hanson, F., & Fifita, M. (2011). *China in the Pacific: The New Banker in Town* [Report]. http://www.jstor.org/stable/resrep10212

Hansson, L. (2018). Science education, indoctrination, and the hidden curriculum. In M. R. Matthews (Ed.), *History, philosophy and science teaching: New perspectives* (pp. 283-306). Springer International Publishing. https://doi.org/10.1007/978-3-319-62616-1_11

Hau‘ofa, ‘E. (1994). Our sea of islands. *The Contemporary Pacific*, *6*(1), 147-161. http://www.jstor.org/stable/23701593

Havea, ‘E. H. (2014). *Koe feliuliuaki ‘o e ‘ea: Ko ha palopalema nai eni? Understanding climate change in Tonga* [Master's thesis, University of Waikato]. Research Commons. https://hdl.handle.net/10289/9075

Havea, ‘E. H. (2020). *Climate change education in Tongan secondary schools* [Doctoral dissertation, The University of Waikato]. Research Commons. https://hdl.handle.net/10289/14011

Havea, T. (2020, December 7). *Tupou I ko e tu‘i lotu mo‘oni (theologian)* [Speech transcript].

Henly, J. (2005). The primary education improvement project of Vanuatu: A model for teacher development in the Pacific. *Directions: Journal of Educational Studies*, *27*(2), 25-36. http://www.directions.usp.ac.fj/cgi-bin/library?e=d-01000-00---off-0direct--00-1--0-10-0---0---0prompt-10---4-------0-1l--11-en-50---20-about---00-3-1-00-0-0-11-1-0utfZz-8-00&a=d&c=direct&cl=CL4.1.53

Herrington, A. J., & Herrington, J. A. (2007). What is an authentic learning environment? In L. A. Tomei (Ed.), *Online and distance learning: Concepts, methodologies, tools, and applications* (Vol. 1, pp. 68-77). Information Science Reference. https://ro.uow.edu.au/cgi/viewcontent.cgi?article=2212&context=edupapers

Hess, S. C. (2009). *Person and place: Ideas, ideals and practice of sociality on Vanua Lava, Vanuatu*. Berghahn Books. https://berghahnbooks.com/title/HessPerson

Hetzel, D., & Pascht, A. (2019). Climate change and livelihood practices in Vanuatu. In C. Klöck & M. Fink (Eds.), *Dealing with climate change on small islands: Towards effective and sustainable adaptation?* (pp. 195-216). Göttingen University Press. https://doi.org/10.17875/gup2019-1208

Hickey, F. R. (2006). Traditional marine resource management in Vanuatu: Acknowledging, supporting and strengthening indigenous management systems. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin*, *20*, 11-23. http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/TRAD/20/TRAD20_11_Hickey.pdf

Hond, R., Ratima, M., & Edwards, W. (2019). The role of Māori community gardens in health promotion: A land-based community development response by Tangata Whenua, people of their land [Supplement article]. *Global Health Promotion*, *26*(3), 44-53, Article 831603. https://doi.org/10.1177/1757975919831603

Hough, D. A., & Skutnabb-Kangas, T. (2005). Beyond good intentions: Combating linguistic genocide in education. *AlterNative: An International Journal of Indigenous Peoples*, *1*(1), 106-127. https://doi.org/10.1177/117718010500100107

Intergovermental Panel on Climate Change. (2014). *Climate change 2014: Impacts, adaption, and vulnerability. Summary for policymakers* (C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea, & L. L. White, Eds.). Cambridge University Press. https://www.ipcc.ch/report/ar5/wg2/

International Federation of Red Cross and Red Crescent Societies. (2014). Tonga: Tropical Cyclone Ian. *Information Bulletin*(1), Article Glide no. 2041-000003. https://www.ifrc.org/docs/Appeals/14/IBtongaTC140114.pdf

Janif, S. Z., Nunn, P. D., Geraghty, P., Aalbersberg, W., Thomas, F. R., & Camailakeba, M. (2016). Value of traditional oral narratives in building climate-change resilience: insights from rural communities in Fiji. *Ecology and Society*, *21*(2). https://doi.org/10.5751/ES-08100-210207

Jegede, O. J., & Aikenhead, G. S. (1999). Transcending cultural borders: Implications for science teaching. *Research in Science & Technological Education*, *17*(1), 45-66. https://doi.org/10.1080/0263514990170104

Jenkins, K. A., & Jenkins, B. A. (2005). Education for sustainable development and the question of balance: Lessons from the Pacific. *Current Issues in Comparative Education*, *7*(2), 114-129, Article EJ853853. https://eric.ed.gov/?id=EJ853853

Jenkins, R. (1992). *Pierre Bourdieu*. Taylor & Francis Group. https://doi.org/10.4324/9780203131527

Jeschonnek, L. (Ed.). (2011). *WorldRiskReport 2011* (Imprimerie Centrale, Trans.). Bündnis Entwicklung Hilft. www.WorldRiskReport.org.

Jeschonnek, L. (Ed.). (2013). *WorldRiskReport 2013* (M. Gardner, Trans.). Bündnis Entwicklung Hilft & United Nations University - Institute for Environment and Human Security. www.WorldRiskReport.org.

Jeschonnek, L., Aberle, M., Kandel, J., Ramm, W. C., & Wiegard, B. (Eds.). (2014). *WorldRiskReport 2014* (M. Gardner, Trans.). Bündnis Entwicklung Hilft & United Nations University - Institute for Environment and Human Security. www.WorldRiskReport.org.

Jeschonnek, L., & Brodbeck, N. (Eds.). (2012). *WorldRiskReport 2012* (M. Gardner, Trans.). Bündnis Entwicklung Hilft. www.WorldRiskReport.org.

Jeschonnek, L., Kirch, L., & Muche, P. (Eds.). (2017). *WorldRiskReport 2017*. Bündnis Entwicklung Hilft www.WorldRiskReport.org.
Jeschonnek, L., Muche, P., Radtke, K., & Walter, J. (Eds.). (2015). *WorldRiskReport 2015* (M. Gardner, Trans.). Bündnis Entwicklung Hilft & United Nations University - Institute for Environment and Human Security. www.WorldRiskReport.org.
Jeschonnek, L., Muche, P., Walter, J., & Kirch, L. (Eds.). (2016). *WorldRiskReport 2016*. Bündnis Entwicklung Hilft & United Nations University - Institute for Environment and Human Security. www.WorldRiskReport.org.
Johansson-Fua, S. (2008). *Faiako ma'a Tonga* [Unpublished manuscript]. Institute of Education, The University of the South Pacific, 'Atele, Tonga. http://repository.usp.ac.fj/id/eprint/5394
Johansson-Fua, S., Manu, S., Takapautolo, T., & Taufe'ulungaki, 'A. M. (2007). *Sustainable livelihood and education in the Pacific: Tonga pilot report*. University of the South Pacific. http://repository.usp.ac.fj/id/eprint/5383
Johnston, I. (2015). Traditional warning signs of cyclones on remote islands in Fiji and Tonga. *Environmental Hazards, 14*(3), 210-223. https://doi.org/10.1080/17477891.2015.1046156
Ka'ili, T. O. (2005). Tauhi vā: Nurturing Tongan sociospatial ties in Maui and beyond. *The Contemporary Pacific, 17*(1), 83-114. https://doi.org/10.1353/cp.2005.0017
Khalifa, M. A., Khalil, D., Marsh, T. E. J., & Halloran, C. (2019). Toward an Indigenous, decolonizing school leadership: A literature review. *Educational Administration Quarterly, 55*(4), 571-614. https://doi.org/10.1177/0013161x18809348
Kim, M., & Dopico, E. (2016). Science education through informal education. *Cultural Studies of Science Education, 11*(2), 439-445. https://doi.org/10.1007/s11422-014-9639-3
Kimmerer, R. W. (2013). The fortress, the river and the garden: A new metaphor for cultivating mutualistic relationship between scientific and traditional ecological knowledge. In A. Kulnieks, D. R. Longboat, & K. Young (Eds.), *Contemporary studies in environmental and Indigenous pedagogies : A curricula of stories and place* (pp. 49-76). Brill | Sense. https://brill.com/view/book/edcoll/9789462092938/BP000005.xml
Kirch, L., Muche, P., & Walter, J. (Eds.). (2018). *WorldRiskReport 2018*. Bündnis Entwicklung Hilft & Ruhr University Bochum - Institute for International Law of Peace and Armed Conflict. www.WorldRiskReport.org.
Kirch, L., Muche, P., & Walter, J. (Eds.). (2019). *WorldRiskReport 2019*. Bündnis Entwicklung Hilft & Ruhr University Bochum - Institute for International Law of Peace and Armed Conflict. www.WorldRiskReport.org.
Kirch, L., Prütz, R., Muche, P., & Karmann, L. (Eds.). (2020). *WorldRiskReport 2020*. Bündnis Entwicklung Hilft & Ruhr University Bochum - Institute for International Law of Peace and Armed Conflict. www.WorldRiskReport.org.
Klint, L. M., Jiang, M., Law, A., Delacy, T., Filep, S., Calgaro, E., Dominey-Howes, D., & Harrison, D. (2012). Dive tourism in Luganville, Vanuatu: Shocks, stressors, and vulnerability to climate change. *Tourism in Marine Environments, 8*(1-2), 91-109. https://doi.org/10.3727/154427312X13262430524225
Kolb, D. A. (1984). The process of experiential learning. In *Experiential learning: Experience as the source of learning and development* (1st ed., pp. 20-38). Prentice Hall. https://learningfromexperience.com/research-library/the-process-of-experiential-learning/
Koloto, 'A. (1998). Change in the Kingdom of Tonga. In K. Sullivan (Ed.), *Education and change in the Pacific Rim: Meeting the challenges* (pp. 119-136). Triangle Journals.

Kraemer, D. (2013). *Planting roots, making place: An ethnography of young men in Port Vila, Vanuatu* [Doctoral dissertation, The London School of Economics and Political Science]. LSE Theses Online. http://etheses.lse.ac.uk/id/eprint/825

Krog, A., Mpolweni-Zantsi, N., & Ratele, K. (2008). The South African Truth and Reconciliation Commission (TRC): Ways of knowing Mrs. Konile. In N. K. Denzin, Y. S. Lincoln, & L. T. Smith (Eds.), *Handbook of critical and Indigenous methodologies* (pp. 531-546). Sage. https://doi.org/10.4135/9781483385686

Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal*, *32*(3), 465-491. https://doi.org/10.3102/00028312032003465

Lafitani, S. F. P. (2011). *Moanan-Tongan fatongia and deontic in Greco-Rome: Fiefia, happiness, of tauelangi, climatic euphoria, and 'alaha kakala, permeating frangrance - Malie! Bravo!* [Doctoral dissertation, Australian Catholic University]. ACU Research Bank. https://acuresearchbank.acu.edu.au/item/86w09/moanan-tongan-fatongia-and-deontic-in-greco-rome-fiefia-happiness-of-tauelangi-climatic-euphoria-and-alaha-kakala-permeating-frangrance-malie-bravo

Lātū, L. V. L. (2018). *Family structure and academic performance of students in secondary schools in the Kingdom of Tonga* [Master's thesis, University of Canterbury]. UC Research Repository. http://hdl.handle.net/10092/15100

Lātū, P. O. (2011). *Fakaongo and tau'ataina: The influences of the Tongan traditional religion, the European civilization and Wesleyan teachings on the formation of Tongan religious identities* [Master's thesis, Massey University]. Massey Research Online. http://hdl.handle.net/10179/3360

Lātū, P. O. (2017). *Ko E Tala-Tukufakaholo 'O Tonga: an alter-native holistic historiography of Tonga history from their own traditional oral culture and through their own people's eyes* [Doctoral dissertation, University of Canterbury]. UC Research Repository. http://hdl.handle.net/10092/14672

Lātūkefu, S. (1967). *Church and state in Tonga : the influence of the Wesleyan Methodist missionaries on the political development of Tonga, 1826-1875* [Doctoral dissertation, Australia National University]. Open Access Theses. http://hdl.handle.net/1885/10786

Laugksch, R. C. (2000). Scientific literacy: A conceptual overview. *Science education*, *84*(1), 71-94. https://doi.org/10.1002/(SICI)1098-237X(200001)84:1<71::AID-SCE6>3.0.CO;2-C

Lave, J. (2009). The practice of learning. In K. Illeris (Ed.), *Contemporary theories of learning: Learning theorists ... in their own words* (pp. 200-208). Routledge. https://doi.org/10.4324/9781315147277

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Lawrence, A. (2019). *Enhancing the conservation effectiveness of seagrass ecosystems supporting globally significant populations of dugongs across the Indian and Pacific Ocean basins*. United Nations Environment Programme & Global Environment Facility. http://hdl.handle.net/20.500.11822/33507

Leckie, A., Langer, L., Ataria, J., Goven, J., & Baker, J. (2020). Four years CIBR research with Te Pā o Rākaihautū. *Biowaste News*(22), 14-16. http://www.cibr.org.nz/assets/CIBR/Reports-papers/Newsletters/CIBR-Newsletter_June2020-with-ISSN.pdf

Lee-Hang, D. M. (2011). *Fa'afatāmanu talafeagai mo lesona fa'asaienisi: O le tu'ualalo mo a'oga a faia'oga saienisi fa'aōliōli. A culturally appropriate formative assessment in science lessons: Implications for initial science teacher education* [Doctoral

dissertation, University of Waikato]. Research Commons. https://hdl.handle.net/10289/5046
Lee, H. (2016). 'I was forced here': perceptions of agency in second generation 'return' migration to Tonga. *Journal of Ethnic & Migration Studies*, *42*(15), 2573-2588. https://doi.org/10.1080/1369183X.2016.1176524
Lefale, P. F. (2010). Ua 'afa le Aso Stormy weather today: traditional ecological knowledge of weather and climate. The Samoa experience. *Climatic change*, *100*(2), 317-335. https://doi.org/10.1007/s10584-009-9722-z
Lemke, J. L. (2001). Articulating communities: Sociocultural perspectives on science education. *Journal of Research in Science Teaching*, *38*(3), 296-316. https://doi.org/10.1002/1098-2736(200103)38:3<296::AID-TEA1007>3.0.CO;2-R
Leslie, E. (2013). *Making a living in Vanuatu: Livelihoods and development in peri-urban Port Vila* [Master's thesis, University of Otago]. Otago University Research Archive. http://hdl.handle.net/10523/4461
Liamputtong, P. (2020). *Qualitative research methods* (5th ed.). Oxford University Press Australia and New Zealand. https://hdl.handle.net/1959.7/uws:57448
Lind, C. (2016). Henry has arisen: Gender and hierarchy in Vanuatu's Anglican Church. *The Australian Journal of Anthropology*, *27*(2), 226-243. https://doi.org/10.1111/taja.12195
Lindstrom, L. (2011). Urbane Tannese: Local perspectives on settlement life in Port Vila. *Journal de la Société des Océanistes*, *133*, 255-266. https://doi.org/10.4000/jso.6461
Lipson, M., Spriggs, M., Valentin, F., Bedford, S., Shing, R., Zinger, W., Buckley, H., Petchey, F., Matanik, R., Cheronet, O., Rohland, N., Pinhasi, R., & Reich, D. (2020). Three phases of ancient migration shaped the ancestry of human populations in Vanuatu. *Current Biology*, *30*(24), 4846-4856.e4846. https://doi.org/10.1016/j.cub.2020.09.035
Love, M., Brown, M. A., Kenneth, S., Ling, G., Tor, R., Bule, M., Ronalea, G., Vagaha, S., Kami, K., & Luki, D. (2019). What's in a name? Case-studies of applied language maintenance and revitalisation from Vanuatu. *Historic Environment*, *31*(3), 86-97. https://australia.icomos.org/publications/historic-environment/he-vol-31-no-3-2019-conserving-it-together-cultural-landscapes-intangible-heritage/
Lovell, E. R., & Palaki, A. (2002). National coral reef status report Tonga. In *Coral reefs in the Pacific: Status and monitoring, Resources and management* (pp. 317-343). https://www.sprep.org/att/IRC/eCOPIES/Countries/Tonga/5.pdf
Lumelume, S. (2007). Teachers and teacher education in Vanuatu In S. J. Fua & K. F. Sanga (Eds.), *Teachers and Education in the Pacific (TEP): A desk study report* (pp. 180-191). Institute of Education, University of the South Pacific and Australia Aid. http://repository.usp.ac.fj/5380/2/Final_Report_TEP_I.pdf
Macfarlane, A., Manning, R., Ataria, J., Macfarlane, S., Derby, M., & Clarke, T. H. (2019). Wetekia kia rere: the potential for place-conscious education approaches to reassure the indigenization of science education in New Zealand settings. *Cultural Studies of Science Education*, *14*(2), 449-464. https://doi.org/10.1007/s11422-019-09923-0
MacIntyre, L. I. K. (2008). *Tongan mothers' contributions to their young children's education in New Zealand = Lukuluku 'a e kau fa'ē Tonga' ki he ako 'enau fānau iiki' 'i Nu'u Sila* [Doctoral dissertation, Massey University]. Massey Research Online. http://hdl.handle.net/10179/1398
Maffi, L. (2005). Linguistic, cultural, and biological diversity. *Annual Review of Anthropology*, *34*, 599-617. https://www.jstor.org/stable/25064900
Maffi, L., & Woodley, E. (2010). *Biocultural diversity conservation: A global sourcebook*. Routledge. https://doi.org/10.4324/9781849774697

Mafi, S. (2018). *Ko e talanoa fekau'aki pea moe mo'ui kakato 'oe mātu'a Tonga nofo Nu'usila* [Master's thesis, Victoria University of Wellington-Te Herenga Waka]. ResearchArchive–Te Puna Rangahau. http://hdl.handle.net/10063/7762

Magee, A. D., Verdon-Kidd, D. C., Kiem, A. S., & Royle, S. A. (2016). Tropical cyclone perceptions, impacts and adaptation in the Southwest Pacific: an urban perspective from Fiji, Vanuatu and Tonga. *Natural Hazards and Earth System Sciences*, *16*(5), 1091-1105. https://doi.org/10.5194/nhess-16-1091-2016

Mahit, L. G. L. (2016). *Reconciling Kastom and modernity in contemporary Vanuatu* [Master's thesis, University of Waikato]. Research Commons. https://hdl.handle.net/10289/10740

Mailau, S., Samani, T., & Fakava, V. (2007). *Tonga national capacity self assessment for global environment management: Thematic assessment report for the United Nations convention to combat desertification in Tonga*. Tonga Department of Environment, Global Enviroment Facility, & United Nations Development Programme. https://www.sprep.org/att/IRC/eCOPIES/Countries/Tonga/51.pdf

Malm, T. (2009). Women of the coral gardens: The significance of marine gathering in Tonga. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin*, *25*, 2-15. https://coastfish.spc.int/en/publications/bulletins/traditional-management/141-traditional-information-bulletin-25

Mannay, D. (2010). Making the familiar strange: Can visual research methods render the familiar setting more perceptible? *Qualitative research*, *10*(1), 91-111. https://doi.org/10.1177/1468794109348684

Manning, R. (2009). *Place, power and pedagogy: A critical analysis of the status of Te Atiawa histories of place in Port Nicholson block secondary schools and the possible application of place-based education models* [Doctoral dissertation, Victoria University of Wellington-Te Herenga Waka]. ResearchArchive-Te Puna Rangahau. http://hdl.handle.net/10063/1051

Manning, R., & Harrison, N. (2018). Narratives of place and land: Teaching indigenous histories in Australian and New Zealand teacher education. *Australian Journal of Teacher Education*, *43*(9), 59-74. https://doi.org/10.14221/ajte.2018v43n9.4

Manning, R., Hetet-Owen, L., Puketapu, T., Puketapu, H., & Manning, J. (2020). Tangata whenuatanga: Reflections on how place-based education approaches may assist kaiako enhance tiriti/treaty relationships in local communities. In A. C. Gunn, N. Surtees, D. Gordon-Burns, & K. Purdue (Eds.), *Te aotūroa tātaki: Inclusive early childhood education* (2nd ed., pp. 54-71). NZCER Press. https://www.nzcer.org.nz/nzcerpress/te-aoturoa-tataki-2nd-ed

Manu'atu, L. (2003). TalanoaMālie -innovative reform through social dialogue in New Zealand *Cultural Survival Quarterly Magazine*, *27*(4). https://www.culturalsurvival.org/publications/cultural-survival-quarterly/talanoamalie-innovative-reform-through-social-dialogue-new

Mariner, W., & Martin, J. (1820). *An account of the natives of Tonga Islands, in the South Pacific Ocean: Compiled and arranged from the extensive communications of William Mariner, several years resident in those islands* (First American ed.). Charles Ewer. https://books.googleusercontent.com/books/content?req=AKW5Qad1fajmigerNFDhITxq5aPAThrXf0psh7ReCeyEaTeBCy3yubtbR0XhYcxXAes_sFRfNaEPP__ADfHQV_g-EZ7BBg2EdExlcZlVC7Rd34aR8Yiq2n2VDmh6chpJ927LI6JRuhD43GEOzg_tFq2sB1BjoL7wZaRFeZnBWaAqn0N3b3hLppGLvXAR51BvA_KQkLWdqAwlRJr0-

WP7RGEuQOnP-LRxxHrQFU02f3DLxBSXAxkU79l-bMPx2m5vS7WI5UJWOpWyuDdZVu2wQnyISoVbXlysCg
Marks, N., Abdallah, S., Simms, A., & Thompson, S. (2006). *The happy planet index: An index of human well-bring and envrionmental impact* (M. Murphy, Ed.). New Economics Foundation & Friends of the Earth. https://neweconomics.org/uploads/files/54928c89090c07a78f_ywm6y59da.pdf
Marshall, C., & Rossman, G. B. (2006). *Designing qualitative research* (4th Revised ed.). Sage Publications.
Marshall, S. J., Whyte, A. L., Hamilton, J. F., & Chambers, G. K. (2005). Austronesian prehistory and polynesian genetics: A molecular view of human migration across the Pacific. *New Zealand Science Review*, *62*(3), 75-80. https://www.researchgate.net/profile/C_Weaver/publication/255696932_Science_dialogues_Talking_about_science/links/0c96053aa0f19dae92000000/Science-dialogues-Talking-about-science.pdf#page=17
Matangitonga. (2020a, January 17). Ministry aims to improve education in Tonga. *Matangitonga Online*. https://matangitonga.to/2020/01/17/solutions-improve-education-tonga
Mather, G. (1997). The politics of educational planning and development in Vanuatu. *Policy, Organisation and Society*, *13*(1), 27-55. https://doi.org/10.1080/10349952.1997.11876658
McBryde, I. (2000). Travellers in storied landscapes: A case study in exchanges and heritage. *Aboriginal History*, *24*, 152-174. https://doi.org/10.22459/AH.24.2011
McCarter, J. (2012). *Variation, transmission, and maintenance of traditional ecological knowledge on Malekula Island, Vanuatu* [Doctoral dissertation, Victoria University of Wellington-Te Herenga Waka]. ResearchArchive–Te Puna Rangahau. http://hdl.handle.net/10063/2236
McCarter, J., & Gavin, M. C. (2011). Perceptions of the value of traditional ecological knowledge to formal school curricula: opportunities and challenges from Malekula Island, Vanuatu. *Journal of ethnobiology and ethnomedicine*, *7*, 1-14, Article 38. https://doi.org/10.1186/1746-4269-7-38
McCarter, J., & Gavin, M. C. (2014). Local Perceptions of Changes in Traditional Ecological Knowledge: A Case Study from Malekula Island, Vanuatu. *Ambio*, *43*(3), 288-296. https://doi.org/10.1007/s13280-013-0431-5
McCarter, J., Gavin, M. C., Baereleo, S., & Love, M. (2014). The challenges of maintaining indigenous ecological knowledge. *Ecology and Society*, *19*(3), Article 39. http://www.jstor.org/stable/26269617
McCarthy, M. B. (1994). *He hinaki tukutuku: Rangatiratanga, Whare Wananga and the state* [Doctoral dissertation, Victoria University of Wellington]. VOCEDplus. http://hdl.voced.edu.au/10707/105753
McEvoy, D., de Ville, N., Komugabe-Dixson, A., & Trundle, A. (2017). *Port Vila: Social mapping and analysis of ecosystem use*. Secretariat of the Pacific Regional Environment Programme. https://pacific-data.sprep.org/dataset/social-mapping-and-analysis-ecosystem-use-port-vila/resource/5ce91319-8941-4bd3-af19
McKinley, E. A., & Smith, L. T. (2019). Towards self-determination in Indigenous education research: An introduction. In E. A. McKinley & L. T. Smith (Eds.), *Handbook of Indigenous education* (1st ed., pp. 1-15). Springer. https://doi.org/10.1007/978-981-10-3899-0
McNamara, K. E., & Gibson, C. (2009). 'We do not want to leave our land': Pacific ambassadors at the United Nations resist the category of 'climate refugees'. *Geoforum*, *40*(3), 475-483. https://doi.org/10.1016/j.geoforum.2009.03.006

Meek, D., Bradley, K., Ferguson, B., Hoey, L., Morales, H., Rosset, P., & Tarlau, R. (2019). Food sovereignty education across the Americas: multiple origins, converging movements. *Agriculture and Human Values*, *36*(3), 611-626. https://doi.org/10.1007/s10460-017-9780-1

Mercer, J. (2010). Disaster risk reduction or climate change adaptation: Are we reinventing the wheel? *Journal of International Development*, *22*(2), 247-264. https://doi.org/10.1002/jid.1677

Mercer, J., Kelman, I., Alfthan, B., & Kurvits, T. (2012). Ecosystem-based adaptation to climate change in Caribbean small island developing states: Integrating local and external knowledge. *Sustainability*, *4*(8), 1908-1932. https://doi.org/10.3390/su4081908

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation* (4th ed.). John Wiley & Sons. https://www.wiley.com/en-ae/Qualitative+Research%3A+A+Guide+to+Design+and+Implementation%2C+4th+Edition-p-9781119003601

Meyer, M. A. (2008). Indigenous and authentic: Hawaiian epistemology and the triangulation of meaning. In *Handbook of critical and Indigenous methodologies* (pp. 217-232). SAGE Publications, Inc. https://doi.org/10.4135/9781483385686

Meyer, M. A. (2014). Hoea Ea: Land education and food sovereignty in Hawai‘i. *Environmental Education Research*, *20*(1), 98-101. https://doi.org/10.1080/13504622.2013.852656

Miller, B. G., & Roehrig, G. (2018). Indigenous cultural contexts for STEM experiences: snow snakes' impact on students and the community. *Cultural Studies of Science Education*, *13*(1), 31-58. https://doi.org/10.1007/s11422-016-9738-4

Monfils, R. (2005). The global risk of marine pollution from WWI shipwrecks: examples from the seven seas. *International Oil Spill Conference Proceedings*, *2005*(1), 1049-1054. https://doi.org/10.7901/2169-3358-2005-1-1049

Moo, D. J. (2006). Nature in the new creation: New Testament eschatology and the environment. *Journal of the Evangelical Theological Society*, *49*(3), 449-488. https://www.etsjets.org/files/JETS-PDFs/49/49-3/JETS_49-3_449-488_Moo.pdf

Morrison, R. J., Denton, G. R. W., Bale Tamata, U., & Grignon, J. (2013). Anthropogenic biogeochemical impacts on coral reefs in the Pacific Islands—An overview. *Deep Sea Research Part II: Topical Studies in Oceanography*, *96*, 5-12. https://doi.org/10.1016/j.dsr2.2013.02.014

Nabobo-Baba, U. (2013). Transformations from within: Rethinking Pacific education initiative. The development of a movement for social justice and equity. *The International Education Journal: Comparative Perspectives*, *12*(1), 82-97. https://openjournals.library.sydney.edu.au/index.php/IEJ/article/view/7439

Naidu, V. (2019). A Commentary on the 50-Year History of the University of the South Pacific. In S. Firth & V. Naidu (Eds.), *Understanding Oceania: Celebrating the University of the South Pacific and its collaboration with the Australian National University* (pp. 11-33). ANU Press. https://doi.org/10.22459/UO.2019

Najike, S. V. (2004). *Learning science in a secondary school in Papua New Guinea* [Doctoral dissertation, Queensland University of Technology]. QUT ePrints. https://eprints.qut.edu.au/15922/

Nalau, J., Becken, S., Schliephack, J., Parsons, M., Brown, C., & Mackey, B. (2018). The role of Indigenous and traditional knowledge in ecosystem-based adaptation: A review of the literature and case studies from the Pacific Islands. *Weather, Climate, and Society*, *10*(4), 851-865. https://doi.org/10.1175/wcas-d-18-0032.1

Nath, D., Mudaliar, M., & Ioan, C. (2006). *Water safety plan: Water supply description assessment Vanuatu*. Water Safety Plans Programme - Vanuatu. https://www.pacificwater.org/userfiles/file/Vanuatu%20-Water%20Supply%20System%20Assessment-new.pdf

Naufahu, M. (2018). A Pasifika research methodology: Talaloto. *Waikato Journal of Education*, *23*(1), 15-24. https://doi.org/10.15663/wje.v23i1.635

New International Version Bible. (2011). *New International Version Bible Online*. The International Bible Society. https://www.biblica.com/online-bible/ (Original work published 1978)

Niatu, A. L. (2007). *Dosalsal, the floating ones : exploring the socio-cultural impacts of cruise ship tourism on Port Vila, Vanuatu residents, and their coping strategies* [Master's thesis, Lincoln University]. Research@Lincoln. https://hdl.handle.net/10182/1383

Niroa, J. (2004). Why we need to re-think Vanuatu education. In K. Sanga, J. Niroa, K. Matai, & L. Crowl (Eds.), *Re-thinking Vanuatu education together* (pp. 25-31). Ministry of Education, Vanuatu & Institute of Pacific Studies, University of the South Pacific.

Niumeitolu, H. T. (2007). *The state and the church, the state of the church in Tonga* [Doctoral dissertation, University of Edinburgh]. Edinburgh Research Archive. http://hdl.handle.net/1842/2236

O'Steen, B., & Perry, L. (2012). Service-learning as a responsive and engaging curriculum: A higher education institution's response to natural disaster. *Curriculum Matters, 8*, 171-186. https://doi.org/10.18296/cm.0144

Obed, L. (n.d.). *The human body* (S. Sumrall-Lloyd, Ed.). Department of Education.

Oppenheimer, M., Glavovic, B. C., Hinkel, J., van de Wal, R., Magnan, A. K., Abd-Elgawad, A., Cai, R., Cifuentes-Jara, M., DeConto, R. M., Ghosh, T., Hay, J., Isla, F., Marzeion, B., Meyssignac, B., & Sebesvari, Z. (2019). Sea level rise and implications for low-lying islands, coasts and communities. In H.-O. Pörtner, D. C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, & N. M. Weyer (Eds.), *IPCC special report on the ocean and cryosphere in a changing climate* (pp. 321-445). Intergovernmental Panel on Climate Change,. https://www.ipcc.ch/site/assets/uploads/sites/3/2019/11/08_SROCC_Ch04_FINAL.pdf

Orr, D. W. (1989). Ecological Literacy. *Conservation Biology*, *3*(4), 334-335. https://doi.org/10.1111/j.1523-1739.1989.tb00238.x

Orr, D. W. (1992). *Ecological literacy: Education and the transition to a postmodern world*. Suny Press. https://www.sunypress.edu/p-1285-ecological-literacy.aspx

Osborne, J. F. (2009). An argument for arguments in science classes. *Phi Delta Kappan*, *91*(4), 62-65. https://www.jstor.org/stable/25594683

Otsuka, Y. (2007). Making a case for Tongan as an endangered language. *The Contemporary Pacific*, *19*(2), 446-473. https://doi.org/10.1353/cp.2007.0064

Palefau, T. H. (2005). *Perspectives on scientific and technological literacy in Tonga: Moving forward in the 21st century* [Doctoral dissertation, University of Toronto]. The Learning and Technology Library.

Patterson, M. E., & Williams, D. R. (2005). Maintaining research traditions on place: Diversity of thought and scientific progress. *Journal of Environmental Psychology*, *25*(4), 361-380. https://doi.org/10.1016/j.jenvp.2005.10.001

Pedersen Zari, M., Blaschke, P. M., Jackson, B., Komugabe-Dixson, A., Livesey, C., Loubser, D. I., Martinez-Almoyna Gual, C., Maxwell, D., Rastandeh, A., Renwick, J.,

Weaver, S., & Archie, K. M. (2020). Devising urban ecosystem-based adaptation (EbA) projects with developing nations: A case study of Port Vila, Vanuatu. *Ocean & Coastal Management*, *184*, 1-11, Article 105037. https://doi.org/10.1016/j.ocecoaman.2019.105037

Phillips, T. B., Ballard, H. L., Lewenstein, B. V., & Bonney, R. (2019). Engagement in science through citizen science: Moving beyond data collection. *Science education*, *103*(3), 665-690. https://doi.org/10.1002/sce.21501

Ping, I. L. L., Halim, L., & Osman, K. (2019). Explicit instruction of scientific argumentation in practical work: A feasibility study. *Creative Education*, *10*(6), 1205-1229, Article 93287. https://doi.org/10.4236/ce.2019.106091

Pole, F. S. (2014). Tradional Tongan farming system: Past and present. In S. Lee (Ed.), *Traditional knowledge and wisdom: Themes from the Pacific Islands* (pp. 226-236). United Nations Educational, Scientific and Cultural Organization. https://www.unesco-ichcap.org/eng/contents/book_list_arc.php?mode=view&code=B0000586&page=8

Pole, S. (2020). *Fisi'inaua 'i vaha - a Tongan migrant's way: a Methodist minister applies Tongan social concepts in a New Zealand setting* (New Zealand Print ed.). Philip Garside Publishing Ltd.

Pond, W. (2011). An introduction to Tonga's natural history. In T. M. Steen & N. L. Drescher (Eds.), *Tonga - land, sea and people* (pp. 78-88). Tonga Research Association.

Preston, L. (2015). The place of place-based education in the Australian primary geography curriculum. *Geographical Education*, *28*, 41-49. https://eric.ed.gov/?id=EJ1085985

Puamau, P. (2004). Re-thinking educational reform in the Pacific. *Directions: Journal of Educational Studies*, *26*(1), 21-41. http://www.directions.usp.ac.fj/collect/direct/index/assoc/D1175036.dir/doc.pdf

Puamau, P. (2005). Principles and processes of educational planning in the Pacific. In P. Puamau & G. R. Teasdale (Eds.), *Educational planning in the Pacific: Principles and guidelines* (pp. 24-44). University of the South Pacific Suva,, Fiji. https://www.usp.ac.fj/index.php?id=2240

Puloka, T. T. M. (2017a). *Kolosi: 'Api ko Fakakaikaimatangi*. Katongā.

Puloka, T. T. M. (2017b). *A parent's dream: A son inspired. Ko e Misi 'a e Mātu'a: Fanguna-loto ma'ae Foha* (V. Puloka & S. Tu'itahi, Eds. Vol. 1). Katongā Limited.

Purcell, S. W. (2014). Value, market preferences and trade of beche-de-mer from Pacific Island sea cucumbers. *PLoS ONE*, *9*(4), e95075. https://doi.org/10.1371/journal.pone.0095075

Queen Sālote Tupou III. (2004). *Songs & poems of Queen Sālote* (M. Taumoefolau, Trans.; E. Wood-Ellem, Ed.). Vava'u Press.

Rangelov, T., Bratrud, T., & Barbour, J. R. (2019). Ahamb (Malekula, Vanuatu) - language contexts. *Language Documentation and Description*, *16*, 86-126. https://hdl.handle.net/10289/12751

Rapport, D. J., & Maffi, L. (2011). Eco-cultural health, global health, and sustainability. *Ecological Research*, *26*(6), 1039-1049. https://doi.org/10.1007/s11284-010-0703-5

Ratuva, S. (2009). Commodifying cultural knowledge: corporatised western science and Pacific indigenous knowledge. *International Social Science Journal*, *60*(195), 153-163. https://doi.org/10.1111/j.1468-2451.2009.01709.x

Ratuva, S. (2014). "Failed" or resilient subaltern communities?: Pacific indigenous social protection systems in a neoliberal world. *Pacific Journalism Review*, *20*(2), 40-58. https://search.informit.org/doi/10.3316/informit.720006458528310

Rawlings, G. (2012). Statelessness, human rights and decolonisation: Citizenship in Vanuatu, 1906-80. *The Journal of Pacific History*, *47*(1), 45-68. https://www.jstor.org/stable/41710205

Rees, T. (1985). The South Pacific board for educational assessment and national fifth form certificates. *Directions: Journal of Educational Studies no.15*, *7*(2), 71-81. http://www.directions.usp.ac.fj/collect/direct/index/assoc/D769911.dir/doc.pdf

Regenvanu, R. (2005). The changing face of "custom" in Vanuatu. *People and Culture in Oceania*, *20*(Special Section: The Pacific in the 21st Century Formation of New Culture and Identity), 37-50. https://dl.ndl.go.jp/view/download/digidepo_10570385_po_ART0008263843.pdf?contentNo=1&alternativeNo=

Regenvanu, R. (2010). The traditional economy as source of resilience in Vanuatu. In T. Anderson & G. Lee (Eds.), *In defence of Melanesian customary land* (pp. 30-33). Aid/Watch & Melanesian Indigenous Land Defence Alliance. https://www.aidwatch.org.au/wp-content/uploads/2014/06/In-Defence-of-Melanesian-Customary-Land.pdf

Republic of Vanuatu. (2006). *Constitution of the Republic of Vanuatu: Laws of the Republic of Vanuatu* [Consolidation Edition 2006]. https://www.gov.vu/index.php/about/constitution-of-vanuatu (Original commencement 1980)

Riessman, C. K. (2000). Stigma and everyday resistance practices: Childless women in South India. *Gender & Society*, *14*(1), 111-135. https://doi.org/10.1177/089124300014001007

Riessman, C. K. (2003). Performing identities in illness narrative: Masculinity and multiple sclerosis. *Qualitative research*, *3*(1), 5-33. https://doi.org/10.1177/1468794103003001O1

Robert, C. (2004). Classroom assessment in Vanuatu schools. In K. Sanga, J. Niroa, K. Matai, & L. Crowl (Eds.), *Re-thinking Vanuatu education together* (pp. 249-254). Ministry of Education, Vanuatu & Institute of Pacific Studies, University of the South Pacific.

Roberts, J. W. (2011). *Beyond learning by doing : Theoretical currents in experiential education*. Taylor & Francis Group. https://www.routledge.com/Beyond-Learning-by-Doing-Theoretical-Currents-in-Experiential-Education/Roberts/p/book/9780415882088

Rodie, F. (2014). *Summative assessment practices of Solomon Islands year nine science teachers* [Doctoral dissertation, University of Waikato]. Research Commons. https://hdl.handle.net/10289/8526

Royer, M.-J. S. (2016). Climate change and traditional ecological knowledge. In J. B. Territory (Ed.), *Climate, environment and cree observations* (pp. 7-33). Springer. https://doi.org/10.1007/978-3-319-25181-3_2

Rozzi, R. (2018). Biocultural homogenization: A wicked problem in the Anthropocene. In R. Rozzi, R. H. May Jr, F. S. Chapin Iii, F. Massardo, M. C. Gavin, I. J. Klaver, A. Pauchard, M. A. Nuñez, & D. Simberloff (Eds.), *From biocultural homogenization to biocultural conservation* (pp. 21-48). Springer International Publishing. https://doi.org/10.1007/978-3-319-99513-7_2

Russell-Ciardi, M. (2006). Place-based education in an urban environment. *Museum International*, *58*(3), 71-77. https://doi.org/10.1111/j.1468-0033.2006.00570.x

Rutjens, B. T., van der Linden, S., & van der Lee, R. (2021). Science skepticism in times of COVID-19. *Group Processes & Intergroup Relations*, *24*(2), 276-283. https://doi.org/10.1177/1368430220981415

Samate, ‘A. F. (2007). Re-imagining the claim that God and Tonga are my inheritance. In E. Wood-Ellem (Ed.), *Tonga and the Tongans: Heritage and identity* (pp. 47-60). Tonga Research Association.

Samu, T. W. (2010). Pacific education: An Oceanic perspective. *MAI Journal*(1), 1-14. http://www.review.mai.ac.nz/mrindex/MR/issue/view/15.html

Sanga, K., & Niroa, J. (2004). First steps and small beginnings in Vanuatu education research. In K. Sanga, J. Niroa, K. Matai, & L. Crowl (Eds.), *Re-thinking Vanuatu education together* (pp. 13-24). Ministry of Education, Vanuatu & Institute of Pacific Studies, University of the South Pacific.

Sanga, K., Niroa, J., Matai, K., & Crowl, L. (Eds.). (2004). *Re-thinking Vanuatu education together*. Ministry of Education, Vanuatu & the Insitute of Pacific Studies, University of the South Pacific.

Sanga, K., Reynolds, M., Houma, S., & Maebuta, J. (2020). Tok stori as pedagogy: an approach to school leadership education in Solomon Islands. *The Australian Journal of Indigenous Education, FirstView*, 1-8. https://doi.org/10.1017/jie.2020.31

Sanga, K., Reynolds, M., Paulsen, I., Spratt, R., & Maneipuri, J. (2018). A tok stori about tok stori: Melanesian relationality in action as research, leadership and scholarship. *Global Comparative Education: Journal of the WCCES, 2*(1), 3-19. https://www.theworldcouncil.net/uploads/8/6/2/1/86214440/gce_wccesjournal_vol2-no1.pdf

Sardos, J., Muller, S., Duval, M.-F., Noyer, J.-L., & Lebot, V. (2016). Root crops diversity and agricultural resilience: a case study of traditional agrosystems in Vanuatu (Oceania). *Agriculture and Human Values*, *33*(3), 721-736. https://doi.org/10.1007/s10460-015-9657-0

Sato, Y. (2014). Tonga’s risky seabed mining ventures. *New Zealand International Review*, *39*(2), 19-20. https://doi.org/10.3316/informit.115068414125250

Secretariat of the Convention on Biological Diversity. (2000). *Sustaining life on earth: How the Convention on Biological Diversity promotes nature and human well-being.* https://www.cbd.int/doc/publications/cbd-sustain-en.pdf

Secretariat of the Pacific Community. (2014). A. Rising oceans, changing lives: final report. In *Assessing vulnerability and adaptation to sea-levelrise: Lifuka Island, Ha'apai, Tonga*. Secretariat of the Pacific Community. https://www.spc.int/DigitalLibrary/Doc/GSD/GEM_Public_Reports/Lifuka_A_Rising_oceans_changing_lives_Final_report.pdf

Secretariat of the Pacific Regional Environment Programme. (2006). *Pacific education for sustainable development framework.* https://www.sprep.org/att/IRC/eCOPIES/Pacific_Region/46.pdf

Secretariat of the Pacific Regional Environment Programme. (2017). *Port Vila ecosystems, climate change and development scenarios*. https://vanuatu-data.sprep.org/system/files/port-vila-ecosystems-climate-change-development-scenarios.pdf

Shing, R. (2006). Oral tradition in Vanuatu and its importance from an historical perspective. *The New Pacific Review: Proceedings of the 16th Pacific History Association Conference, 3*, 199-204. http://hdl.handle.net/1885/14747

Shipman, T. S. (2008). *Wanem we mifala i wantem [what we want]: A community perspective of vernacular education in Vanuatu* [Master's thesis, University of Hawaii at Manoa]. ScholarSpace. http://hdl.handle.net/10125/20824

Skutnabb-Kangas, T. (2009). MLE for global justice: Issues, approaches, opportunities. In A. K. Mohanty, M. Panda, R. Phillipson, & T. Skutnabb-Kangas (Eds.), *Multilingual*

education for social justice: Globalising the local (pp. 36-59). Orient Blackswan. https://orientblackswan.com/details?id=9788125036982
Skutnabb-Kangas, T. (2013). Today's Indigenous education is a crime against humanity: Mother-tongue-based multilingual education as an alternative? *TESOL in Context*, *23*(1/2), 82-124. https://search.informit.org/doi/abs/10.3316/ielapa.114882084412668
Smith, L. T. (1999). *Decolonizing methodologies: research and indigenous peoples*. Zed Books. https://www.zedbooks.net/shop/book/decolonizing-methodologies/
Soaladaob, K. (2010). *Cultivating identities: Re-thinking education in Palau* [Master's thesis, University of Canterbury]. UC Research Repository. http://hdl.handle.net/10092/5889
Sopu, H. T., Chisaki, Y., & Usagawa, T. (2016). Use of Facebook by secondary school students at Nuku'alofa as an indicator of e-readiness for e-learning in the Kingdom of Tonga. *International Review of Research in Open and Distributed Learning*, *17*(4), 203-223. https://doi.org/10.19173/irrodl.v17i4.2333
Steenbergen, D. J., Neihapi, P. T., Koran, D., Sami, A., Malverus, V., Ephraim, R., & Andrew, N. (2020). COVID-19 restrictions amidst cyclones and volcanoes: A rapid assessment of early impacts on livelihoods and food security in coastal communities in Vanuatu. *Marine Policy*, *121*, 1-7, Article 104199. https://doi.org/https://doi.org/10.1016/j.marpol.2020.104199
Stern, M. (2017). Is music a "safe place"? The creative and reactive construction of urban youth through reggae music (Port Vila, Vanuatu). *Journal de la Société des Océanistes*, *144-145*, 117-130. https://doi.org/10.4000/jso.7852
Stuckey, M., Hofstein, A., Mamlok-Naaman, R., & Eilks, I. (2013). The meaning of 'relevance' in science education and its implications for the science curriculum. *Studies in Science Education*, *49*(1), 1-34. https://doi.org/10.1080/03057267.2013.802463
Suaalii-Sauni, T., & Fulu-Aiolupotea, S. M. (2014). Decolonising Pacific research, building Pacific research communities and developing Pacific research tools: The case of the talanoa and the faafaletui in Samoa. *Asia Pacific Viewpoint*, *55*(3), 331-344. https://doi.org/10.1111/apv.12061
Suda, K. (2013). Marine resource use in transition: Modern fishing in Tonga, Western Polynesia. In R. Ono, A. Morrison, & D. Addison (Eds.), *Prehistoric marine resource use in the Indo-Pacific regions* (pp. 183-191). Australian National University Press. https://doi.org/10.22459/TA39.12.2013
Tabani, M. (2017). Development, tourism and commodification of cultures in Vanuatu. In E. Gnecchi-Ruscone & A. Paini (Eds.), *Tides of Innovation in Oceania: Value, materiality and placenull* (pp. 225-260). ANU Press. https://doi.org/10.22459/TIO.04.2017
Takano, T., Higgins, P., & McLaughlin, P. (2009). Connecting with place: implications of integrating cultural values into the school curriculum in Alaska. *Environmental Education Research*, *15*(3), 343-370. https://doi.org/10.1080/13504620902863298
Tambe, L. (2004). Partnerships between parents, teachers, and children. In K. Sanga, J. Niroa, K. Matai, & L. Crowl (Eds.), *Re-thinking Vanuatu education together* (pp. 263-277). Ministry of Education, Vanuatu & Institute of Pacific Studies, University of the South Pacific.
Tapa'atoutai-Teisina, S. (2020). *Ko e Fungani Mo'onia 'o e Faiako Ma'a Tonga: Understanding the professional attitudes of the valued teachers of Tonga* [Doctoral dissertation, The University of Waikato]. Research Commons. https://hdl.handle.net/10289/13759
Tapia, I. S. (2020). Introduction: A broad look at contextualization of science education across national contexts. In I. Sánchez Tapia (Ed.), *International Perspectives on the*

Contextualization of Science Education (pp. 1-12). Springer International Publishing. https://doi.org/10.1007/978-3-030-27982-0_1

Tari, F. (2004). Improving school performance. In K. Sanga, J. Niroa, K. Matai, & L. Crowl (Eds.), *Re-thinking Vanuatu education together.* (pp. 95-106). Ministry of Education, Vanuatu & Institute of Pacific Studies, University of the South Pacific.

Tarosa, G. (2013). *Exploring the process of educational change in English medium senior secondary school assessment in Vanuatu* [Master's thesis, University of Waikato]. Research Commons. https://hdl.handle.net/10289/8501

Tarosa, G., Edwards, F., & Branson, C. (2016). Organisational learning and development: A Vanuatu educational perspective. *Waikato Journal of Education, 21*(1), 77-88. https://doi.org/10.15663/wje.v21i1.188

Tarosa, G. H. (2020). *Becoming a teacher: Experiences and perceptions of beginning teachers in Vanuatu secondary schools* [Doctoral dissertation, The University of Waikato]. Research Commons. https://hdl.handle.net/10289/14009

Tatafu, M., Booth, E., & Wilson, M. (1997). Secondary school failure in Tonga: Implications for in service and pre service teacher development. *Directions-Journal of Educational Studies, 79*(1), 55-81. http://www.directions.usp.ac.fj/collect/direct/index/assoc/D770132.dir/doc.pdf

Taufe‘ulungaki, ‘A. M. (1979). Curriculum development in Tonga: Then and now. *Directions: Journal of Educational Studies, 3*, 25-35. http://www.directions.usp.ac.fj/collect/direct/index/assoc/D769828.dir/doc.pdf

Taufe‘ulungaki, ‘A. M. (1994). Language community attitudes and their implications for the maintenance and promotion of the Tongan language. *Directions: Journal of Educational Studies, 16*(1), 84-108. http://www.directions.usp.ac.fj/collect/direct/index/assoc/D770089.dir/doc.pdf

Taufe‘ulungaki, ‘A. M. (1999). The teaching of vernacular languages in the Pacific with special reference to Tonga. *Pacific curriculum network, 8*(2), 2-4. http://www.directions.usp.ac.fj/collect/direct/index/assoc/D1065078.dir/doc.pdf

Taufe‘ulungaki, ‘A. M., Veikune, A. H., Early, R., & Spratt, R. (2020). Pacific pedagogies for literacy and language development: Exploring a research-practice intervention. In (pp. 29-43). Institute of Education, USP.

Taylor, J. P. (2008). *The Other Side : Ways of Being and Place in Vanuatu*. University of Hawai'i Press. https://www.jstor.org/stable/j.ctt6wr0wh

Taylor, S. J., Bogdan, R., & DeVault, M. (2015). *Introduction to qualitative research methods: A guidebook and resource* (4th ed.). John Wiley & Sons. https://www.wiley.com/en-us/Introduction+to+Qualitative+Research+Methods%3A+A+Guidebook+and+Resource%2C+4th+Edition-p-9781118767290

Teasdale, G. R. (2005). International perspectives on education for planners. In P. Puamau & G. R. Teasdale (Eds.), *Educational planning in the Pacific: Principles and guidelines* (pp. 1-13). University of the South Pacific Suva,, Fiji.

Thaman, K. H. (1990, July 6-10). *Towards a culture-sensitive model of curriculum development for Pacific Island Countries* [Invited plenary paper]. World Council for Curriculum and Instruction Regional Conference, Sydney, Australia. http://www.directions.usp.ac.fj/collect/direct/index/assoc/D769995.dir/doc.pdf

Thaman, K. H. (1992a, June 8-12). Looking towards the source: A consideration of (cultural) context in teacher education. [Conference presentation]. Pacific Teacher Education Forward Planning Meeting:, The University of the South Pacific. http://www.directions.usp.ac.fj/collect/direct/index/assoc/D770044.dir/doc.pdf.

Thaman, K. H. (1992b). Towards culture sensitive curriculum development. *Pacific curriculum network*, *1*(1), 3-5. http://www.directions.usp.ac.fj/collect/direct/index/assoc/D1074256.dir/doc.pdf
Thaman, K. H. (1993). Culture and the curriculum in the South Pacific. *Comparative education*, *29*(3), 249-260.
Thaman, K. H. (1998a). Equity in, and access to, what kind of education?: some issues for consideration in the Pacific Islands. *Directions: Journal of Educational Studies*, *20*(2), 3-21. http://www.directions.usp.ac.fj/cgi-bin/library?e=d-01000-00---off-0direct--00-1--0-10-0---0---0prompt-10---4-------0-1l--11-en-50---20-about---00-3-1-00-0-0-11-1-0utfZz-8-00&a=d&c=direct&cl=CL4.1.40&d=D770150
Thaman, K. H. (1998b, Wednesday 1st April 1998). Learning to Be: a view from the Pacific Islands. [Conference presentation]. UNESCO Conference on Education for the 21st Century in the Asia-Pacific region Melbourne, Australia. https://vital.voced.edu.au/vital/access/services/Download/ngv:14070/SOURCE2?view=true.
Thaman, K. H. (1999). Different eyes: Schooling and indigenous education in Tonga. In F. E. Leach & A. W. Little (Eds.), *Education, culture and economics: Dilemmas for development* (pp. 69-80). RoutledgeFalmer. https://doi.org/10.4324/9781315052144
Thaman, K. H. (2001). Open and flexible learning for whom? Rethinking distance education. *Directions: Journal of Educational Studies*, *23*(1), 3-22. http://www.directions.usp.ac.fj/collect/direct/index/assoc/D770198.dir/doc.pdf
Thaman, K. H. (2003). Decolonizing Pacific studies: Indigenous perspectives, knowledge, and wisdom in higher education. *The Contemporary Pacific*, *15*(1), 1-17. https://doi.org/10.1353/cp.2003.0032
Thaman, K. H. (2008). Nurturing relationships and honouring responsibilities: a pacific perspective. *International review of education*, *54*(3/4), 459-473. https://doi.org/10.1007/s11159-008-9092-1
Thaman, K. H. (2009). Towards cultural democracy in teaching and learning with specific references to Pacific Island Nations (PINs). *International Journal for the Scholarship of Teaching and Learning*, *3*(2), 1-9, Article 6. https://doi.org/10.20429/ijsotl.2009.030206
Thaman, R. R., Elevitch, C. R., & Wilkinson, K. M. (2000). Multipurpose trees for agroforestry in the Pacific Islands. In C. R. Elevitch & K. M. Wilkinson (Eds.), *Agroforestry guides for Pacific Islands* (pp. 24-69). Permanent Agriculture Resources. https://www.agroforestry.org/books/agroforestry-guides-for-pacific-islands
Thomas, J. (2013). *A History of Tonga, as recorded by Rev. John Thomas* (N. Statham, Ed.). The Bible Society in Korea.
Tolbert, S., Knox, C., & Salinas, I. (2019). Framing, adapting, and applying: Learning to contextualize science activity in multilingual science classrooms. *Research in Science Education*, *49*(4), 1069-1085. https://doi.org/10.1007/s11165-019-9854-8
Tomaselli, K. G., Dyll, L., & Francis, M. (2008). 'Self'and 'Other,'. In N. K. Denzin, Y. S. Lincoln, & L. T. Smith (Eds.), *Handbook of Critical and Indigenous Methodologies* (pp. 347-372). Sage. https://us.sagepub.com/en-us/nam/book/handbook-critical-and-indigenous-methodologies
Tonga College 'Atele. (2013). *Hisitolia 'o e kolisi Tonga*. Tonga College 'Atele. https://www.tongacollege.org/history/history/
Tonga Department of Environment. (2004). *Tonga biodiversity stocktaking* (N. Prescott & P. S. Folaumoetu'i, Eds.) [Technical report]. Taulua Press. https://www.sprep.org/att/IRC/eCOPIES/Countries/Tonga/10.pdf

Tonga Department of Environment. (2020). *Kingdom of Tonga's sixth national repoart to the Convention on Biological Diversity*. His Majesty's Government of the Kingdom of Tonga. https://www.cbd.int/doc/nr/nr-06/to-nr-06-en.pdf

Tonga Education Act 2013. https://www.ilo.org/dyn/natlex/docs/ELECTRONIC/98654/117468/F-2000392432/TON98654.pdf

Tonga Ministry of Agriculture Food Forests and Fisheries. (2015). *2015 Tonga national agricultural census: Main report*. Government of Tonga & Food and Agriculture Organisation of the United Nations. https://tongastats.gov.to/download/7/agriculture/213/tonga-national-agricultural-census-report-2015.pdf

Tonga Ministry of Education and Training. (2014a). *Annual statistical digest, 2014: Tonga Ministry of Education*. Government of Tonga, Pacific Community & Australian Aid. http://www.spc.int/DigitalLibrary/Doc/SDD/Education/TO/Tonga_2014_Education_Statistics_Digest.pdf

Tonga Ministry of Education and Training. (2014b). *Fokotu'utu'u ki he Lea 'o e Akó 'i Tongá ni* (V. Silapá, Ed.). Government of Tonga. http://eduadmin.supremecenter300.com/docs/Tu'utu'uni%20ki%20he%20Lea%20Final.pdf (Original work published 2008)

Tonga Ministry of Education and Training. (2015). *Science syllabus for secondary schools in Tonga: Class 9 - 10* (T. Pahulu, Ed. 2nd ed.). Government of Tonga. (Original work published: 2013)

Tonga Ministry of Education and Training. (2017). *Science syllabus & prescription: Class 9 - class 13 for secondary schools in Tonga* (T. Pahulu, Ed. Final ed.). Government of Tonga. (Original work published 2016)

Tonga Ministry of Education and Training. (2021). *2020 Tonga School Certificate (TSC) results* [Press release]. https://www.facebook.com/PotungaueAko/photos/a.200723611383345/2710603876833000/

Tonga Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications. (2019). *Third national communication on climate change report* (L. T. Malolo, L. K. Moala, A. M. L. Kautoke, & A. L. T. Fine, Eds.). Kingdom of Tonga. https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/158047_Tonga-NC3-1-Final%20TNC%20Report_December%202019.pdf

Tonga, S. (2020). *"Manatu 'Ofa ki 'Api" (remembrance of home in love): Home and diaspora–Leimatu'a remittance fundraising* [Master's thesis, Auckland University of Technology]. Tuwhera Open Thesis and Dissertations. http://hdl.handle.net/10292/13815

Tonga Statistics Department. (2017). *Tonga 2016 census of population and housing: Basic tables and administrative report*. Government of Tonga. https://tongastats.gov.to/download/60/2016/4062/2016-census-report-volume-1-2nd-edition.pdf

Tonga Statistics Department. (2019). *Tonga 2016 census of population and housing: Analytical report*. Government of Tonga. https://tongastats.gov.to/download/60/2016/3746/2016-census-report-volume-2.pdf

Tuafuti, P. (2010). Additive bilingual education: Unlocking the culture of silence. *Mai Review*(1), 1-14. http://www.review.mai.ac.nz/mrindex/MR/article/view/305/397.html

Tuhiwai Smith, L. (2021). *Decolonizing methodologies: Research and Indigenous peoples* (1 ed.). Zed Books. https://doi.org/10.5040/9781350225282

Tu‘itahi, S. (2005). *Langa fonua: in search of success: how a Tongan Kainga strived to be socially and economically successful in New Zealand* [Master's thesis, Massey University]. Massey Research Online. http://hdl.handle.net/10179/7828

Tukuitonga, C. (2017). The future of Pacific regionalism: Challenges and prospects. *Pacific Dynamics: Journal of Interdisciplinary Research, 1*(2), 340-347. https://doi.org/10.26021/879

Twance, M. (2019). Learning from land and water: exploring mazinaabikiniganan as indigenous epistemology. *Environmental Education Research, 25*(9), 1319-1333. https://doi.org/10.1080/13504622.2019.1630802

Uasike, L. (2001). “Faithful unto death:” Jesus' discipleship is a paradigm for Christian ministry. In L. Fuka-Tu‘i tupou & R. Roberts (Eds.), *Tonga - women & theological impact* (pp. 15-28). Ralph Roberts.

United Nations Educational Scientific and Cultural Organization. (2010). *Climate change education for sustainable development* (T. Mermer, Ed.). https://www.knes.edu.kw/adminpanel/public/.pdf,docx,doc,xls/1571744595-36337917.pdf

United Nations Educational Scientific and Cultural Organization. (2017a). *Education for sustainable development goals: Learning objectives*. https://unesdoc.unesco.org/ark:/48223/pf0000247444

United Nations Educational Scientific and Cultural Organization. (2017b). *Local knowledge, global goals*. https://unesdoc.unesco.org/ark:/48223/pf0000259599

United Nations Educational Scientific and Cultural Organization. (2020). *ESD for 2030: What’s next for education for sustainable development?* https://en.unesco.org/news/esd-2030-whats-next-education-sustainable-development

United Nations Office for the Coordination of Humanitarian Affairs. (2014, July). Recap of the Pacific disaster season. *Humanitarian Bulletin: Pacific Islands*, 2. https://reliefweb.int/report/tonga/pacific-islands-humanitarian-bulletin-july-2014

United Nations Office for the Coordination of Humanitarian Affairs. (2015). *Vanuatu: Tropical Cyclone Pam* (Situation report 17). https://reliefweb.int/report/vanuatu/vanuatu-tropical-cyclone-pam-situation-report-no-17-8-april-2015

United Nations’ Environment Programme. (2002). *Dugong: status report and action plans for countries and territories* (H. Marsh, H. Penrose, C. Eros, & J. Hugues, Eds.). UN Environment Programme, International Union for Conservation of Nature, James Cook University, & Cooperative Research Centre for the Great Barrier Reef World Heritage Area. https://portals.iucn.org/library/sites/library/files/documents/2002-001.pdf

Vaioleti, T. M. (2006). Talanoa research methodology: A developing position on Pacific research. *Waikato Journal of Education*, *12*, 21-34. https://doi.org/10.15663/wje.v12i1.296

Vaioleti, T. M. (2013). Talanoa: Differentiating the talanoa research methodology from phenomenology, narrative, Kaupapa Maori and feminist methodologies. *Te Reo, 56/57*, 191-212. https://search.informit.org/doi/abs/10.3316/informit.674853083445219

Vaioleti, T. M., & Morrison, S. L. (2019). The value of Indigenous knowledge to education for sustainable development and climate change education in the Pacific. In E. A. McKinley & L. T. Smith (Eds.), *Handbook of Indigenous Education* (pp. 651-670). Springer Singapore. https://doi.org/10.1007/978-981-10-3899-0_8

Vaka-Vivili, M. K. (2014). *The future of science teacher education in Tonga* [Master's thesis, Victoria University of Wellington-Te Herenga Waka]. ResearchArchive-Te Puna Rangahau. http://hdl.handle.net/10063/8734

Vakapuna, V. H.-V.-I.-M. (2019). *Access, transition, and exclusion in lower secondary schools in Tonga* [Master's thesis, University of the South Pacific]. USP Thesis Collection. http://digilib.library.usp.ac.fj/gsdl/collect/usplibr1/index/assoc/HASH0147.dir/doc.pdf

van der Velde, M., Green, S. R., Vanclooster, M., & Clothier, B. E. (2007). Sustainable development in small island developing states: Agricultural intensification, economic development, and freshwater resources management on the coral atoll of Tongatapu. *Ecological Economics*, *61*(2-3), 456-468. http://www.scopus.com/inward/record.url?eid=2-s2.0-33847403152&partnerID=40&md5=3a11d3a68c7530238d889a9001da96e3

Vandeputte-Tavo, L. (2013). New technologies and language shifting in Vanuatu. *Pragmatics*, *23*(1), 169-179. https://doi.org/10.1075/prag.23.1.08van

Vanuatu Department of Environmental Protection and Conservation. (n.d.). *Vanuatu national biodiversity strategy and action plan (NSAP) 2018-2030*. https://www.sprep.org/attachments/VirLib/Vanuatu/nbsap-2018-2030.pdf

Vanuatu Ministry of Education. (1997a). *Basic science for Vanuatu: Year 10 teacher's guide* (Revised ed.). Government of Vanuatu. (Original work published 1987)

Vanuatu Ministry of Education. (1997b). *Vanuatu agriculture syllabus: Years 7 to 10* (Revised ed.). (Original work published 1993)

Vanuatu Ministry of Education. (2006). *Vanuatu education sector strategy 2007-2016*. Government of Vanuatu. https://moet.gov.vu/docs/policies/Vanuatu%20Education%20Sector%20Strategy_2007-2016.pdf

Vanuatu Ministry of Education. (2010a). *Vanuatu national curriculum statement*. Government of Vanuatu.

Vanuatu Ministry of Education. (2010b). *Vanuatu National Curriculum Statement*. Government of Vanuatu. http://education.gov.vu/docs/curriculum/General/Vanuatu%20National%20Curriculum%20Statement%20-%20English_2010.pdf

Vanuatu Ministry of Education. (2012). *Vanuatu National Language Policy 2012*. Government of Vanuatu. https://moet.gov.vu/docs/policies/Vanuatu%20National%20Language%20Policy%20(English)_2012.pdf

Vanuatu Ministry of Education and Training. (2020a). *2019 Annual Report*. Vanuatu Government. https://education.gov.vu/docs/annual-reports/MoET%20Annual%20Report%202019_2019.pdf

Vanuatu Ministry of Education and Training. (2020b). *Education statistics: Basic tables of 2019*. Government of Vanuatu. https://moet.gov.vu/docs/statistics/2019%20MoET%20Education%20Statistics%20Report_2020.pdf

Vanuatu Ministry of Education and Training. (2020c). *Vanuatu Education and Training Sector Strategic Plan 2020 - 2030*. Government of Vanuatu. http://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/vanuatu_education-training-sector-strategic-plan-2020-2030.pdf

Vanuatu National Advisory Committee on Climate Change. (n.d.). *National adaptation programme for action (NAPA)*. Republic of Vanuatu. https://unfccc.int/resource/docs/napa/vut01.pdf

Vanuatu National Statistics Office. (2017). *2016 post-TC Pam mini-census report; Volume 1: Basic tables*. Ministry of Finance and Economic Management. https://vnso.gov.vu/index.php/en/census-and-surveys/census/2006-mini-census

Vanuatu Project Management Unit. (2016, July 2016). *Vanuatu tourism infrastructure project* [Press release]. https://vpmu.gov.vu/images/newsletter/VTIP_Monthly_Newsletter_July_2016_English.pdf

Varani-Norton, E. E. (2017). Itaukei Indigenous Fijian" Masi" as an education framework: Retaining and adapting tradition in epistemology and pedagogy for a globalised culture. *International Education Journal: Comparative Perspectives*, *16*(2), 131-145. https://eric.ed.gov/?id=EJ1146667

Veatupu, L., Puloka, V., Smith, M., McKerchar, C., & Signal, L. (2019). Me'akai in Tonga: Exploring the Nature and Context of the Food Tongan Children Eat in Ha'apai Using Wearable Cameras. *International journal of environmental research and public health*, *16*(10), 1681. https://doi.org/10.3390/ijerph16101681

Vois Blong Manples Tv. (2019, June 4). *Vois Blo Manples#5* [Video]. YouTube. https://www.youtube.com/watch?v=4qa5JlivXXs

Walshe, R. A., & Nunn, P. D. (2012). Integration of indigenous knowledge and disaster risk reduction: A case study from Baie Martelli, Pentecost Island, Vanuatu. *International Journal of Disaster Risk Science*, *3*(4), 185-194. https://link.springer.com/article/10.1007/s13753-012-0019-x

Wang, B. (2018, January 25). China's assistance beneficial for Pacific Islands, says Ambassador. *Matangitonga*. https://matangitonga.to/2018/01/25/china-s-assistance-beneficial-pacific-islands

Warrick, O. (2009). Ethics and methods in research for community-based adaptation: Reflections from rural Vanuatu. *Participatory learning and action*, *60*(Community-based adaption to climate change), 76-87. https://www.iied.org/pla-60-community-based-adaptation-climate-change

Warsal, D. (2009). *The impact of culture on women's leadership in Vanuatu secondary schools* [Master's thesis, The University of Waikato]. Research Commons. https://hdl.handle.net/10289/2776

Weiner, M. A. (1970). *Medical plants of Tonga* [Master's thesis, University of Hawai‘i at Manoa]. ScholarSpace. http://hdl.handle.net/10125/36042

Weir, T., Dovey, L., & Orcherton, D. (2017). Social and cultural issues raised by climate change in Pacific Island countries: an overview. *Regional Environmental Change*, *17*(4), 1017-1028. https://doi.org/10.1007/s10113-016-1012-5

Welle, T., & Birkmann, J. (2015). The World Risk Index – An approach to assess risk and vulnerability on a global scale. *Journal of Extreme Events*, *02*(01), 34, Article 1550003. https://doi.org/10.1142/s2345737615500037

Wentworth, C. (2016). Public eating, private pain: Children, feasting, and food security in Vanuatu. *Food and Foodways*, *24*(3-4), 136-152. https://doi.org/10.1080/07409710.2016.1210888

White, L. (1967). The Historical Roots of Our Ecologic Crisis. *Science*, *155*(3767), 1203-1207. http://www.jstor.org/stable/1720120

Whitmee, S., Haines, A., Beyrer, C., Boltz, F., Capon, A. G., de Souza Dias, B. F., Ezeh, A., Frumkin, H., Gong, P., Head, P., Horton, R., Mace, G. M., Marten, R., Myers, S. S., Nishtar, S., Osofsky, S. A., Pattanayak, S. K., Pongsiri, M. J., Romanelli, C., Soucat, A., Vega, J., & Yach, D. (2015). Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health. *The Lancet*, *386*(10007), 1973-2028. https://doi.org/10.1016/S0140-6736(15)60901-1

Whyte, K. (2020). Against crisis epistemology. In B. Hokowhitu, A. Moreton-Robinson, L. Tuhiwai-Smith, C. Andersen, & S. Larkin (Eds.), *Routledge Handbook of Critical Indigenous Studies* (1st ed., pp. 52-64). Taylor & Francis Group. https://doi.org/10.4324/9780429440229

Willans, F. (2016). Another early-exit transitional model doomed to fail? Or is this the wrong model at the right time in Vanuatu? *Journal of Multilingual and Multicultural Development*, *38*(8), 699-711. https://doi.org/10.1080/01434632.2016.1233186

Wires, K. N., & LaRose, J. (2019). Sogorea Te'Land Trust and Indigenous Food Sovereignty in the San Francisco Bay Area. *Journal of Agriculture, Food Systems, and Community Development*, *9*(B), 31-34.

Wise, M. (2019). *Serving in the kingdom: a volunteer experience in the development of efl literacy in Tonga* [Master's thesis, Humboldt State University]. HSU theses and projects. https://digitalcommons.humboldt.edu/etd/281

Wood-Ellem, E. (1981). *Queen Sālote Tupou III and Tungī Mailefihi: A study of leadership in twentieth-century Tonga (1918-41)* [Doctoral dissertation, University of Melbourne].

Woodley, E. (2010). Cross-cutting analysis of the projects. In L. Maffi & E. Woodley (Eds.), *Biocultural diversity conservation: A global sourcebook* (pp. 129-153). Earthscan. https://doi.org/10.4324/9781849774697

Wooltorton, S., Collard, L., Horwitz, P., Poelina, A., & Palmer, D. (2020). Sharing a place-based Indigenous methodology and learnings. *Environmental Education Research*, *26*(7), 917-934. https://doi.org/10.1080/13504622.2020.1773407

Yazan, B. (2015). Three approaches to case study methods in education: Yin, Merriam, and Stake. *The Qualitative Report*, *20*(2), 134-152. https://doi.org/10.46743/2160-3715/2015.2102

Young-Leslie, H., & Evans, M. (2001). Understanding differences and similarities. In R. B. Morrison & C. R. Wilson (Eds.), *Ethnographic Essays in Cultural Anthropology: A Problem-Based Approach* (pp. 1-27). F.E. Peacock Publishers.

Appendix A: Approval to Research in Ha'apai from the Tonga Ministry of Education and Training and Vanuatu from the Vanuatu Cultural Centre.

MINISTRY OF EDUCATION AND TRAINING
NUKU'ALOFA
TONGA

INTERNAL MEMO

TO : Chief Executive Officer for Education and Training

FROM : Chief Education Officer for Administration

SUBJECTS : **Request for Endorsement of Application to conduct Educational Research in Tonga towards a Masters of Education Degree - Ms Emma Puloka**

DATE : 12th August, 2015 **REF.** : 43/1/1

The Ministry has received an application from Ms Emma C. Puloka, a Tongan Government Scholarship recipient, studying in Christchurch, to conduct research in Tonga regarding secondary school science education and particularly regarding the environment. Her research will involve investigating how the Form 4 students of Ha'apai conceptualize local environmental issues given the multiple environmental challenges they have faced as well as how their science curriculum and syllabus frames environmental issues. She is proposing to carry out her research over a 4 week period sometime between July and October, 2015.

Cabinet Decision No. 600 of 15th July, 2011 on Government Research Policy stipulates that Government sponsored masters students shall be exempted from the conditions of Government Research Policy, and with the approval to carry out research given by the Chief Executive Officer of the relevant Government Ministry.

Attached herewith are her letter of application and a supporting letter from Associated Professor Lindsey Conner of the University of Canterbury, Christchurch, New Zealand.

Recommendation:

1. That approval be granted for Ms. Emma Puloka, of the University of Canterbury, to conduct her research in Tonga and particularly, in the Ha'apai Secondary Schools on science education and the environment, for a 4 week period between July and October, 2015.

Respectfully submitted for your consideration and endorsement, please.

Lola Baker-Tokotaha
Chief Education Officer for Administration.

DECISIONS:

DECISION	*Signature of the Acting Chief Executive Office for Education and Training* **Mr Claude Tupou**	Date
Approved	MINISTRY OF EDUCATION AND TRAINING TONGA	07/15
Not Approved		
Discuss		
Other comments		

VANUATU NASONAL KALJORAL KAONSEL
Vanuatu National Cultural Council
Conseil National de la Culture de Vanuatu

VANUATU KALJORAL SENTA
Vanuatu Cultural Centre
Centre Culturel de Vanuatu

P.O. Box 184, Port-Vila, Vanuatu Tel: 22129 Fax: 26590 vks@vanuatuculture.org

APPLICATION FORM FOR RESEARCH IN VANUATU

All research in Vanuatu falls under the jurisdiction of the Vanuatu Cultural Centre and the Vanuatu National Cultural Council which must be notified of any research activity in the country. Please, answer to the following questions before to send your query to abong.marcellin@vanuatuculture.org

1- Name: EMMA
2- Surname: PULOKA
3- Name of your institution: UNIVERSITY OF CANTERBURY (Te Whare Wānanga o Waitaha)
4- Address of the institution: 20 KIRKWOOD AVE, ILAM, CHRISTCHURCH, NZ.
5- Phone: (64) 21025375 05
6- Email: emma.puloka@pg.canterbury.ac.nz OR sparrow84one@gmail.com
7- Subject of your research (please, attach 1 or 2 pages giving details about your subject and about partners and funds engaged) :

"Exploring Conceptualizations of Environmental Issues in Science Classes: talanoa from the South Pacific"

Please refer to research proposal attached.

8- Location in Vanuatu: Port Vila
9- How many persons are included in the staff coming for this research? 0
10- How long time will you stay in Vanuatu? From 24 June To 8 July
11- Is it the first time you come as researcher in Vanuatu? (Yes) - No (If not, please indicated the title, the subject and the location in Vanuatu of your last researches)
12- How your research will be used after your fieldwork in Vanuatu (publication, seminar, documentary, etc.)? The research will be used primarily..

OK. by Susie. 13/6/16

in my PhD thesis which is being completed through UC College of Education, Health & Human Development. Also to be used in conferences and publications resulting from PhD.

I declare on my word of honor that the information provided above is true and complete and that I am aware that any incorrect statements may invalidate my expression of interest.

Date : 27th May, 2016
Location : Christchurch, New Zealand
Signature (s) : Emma C. Pulóka

approved
14/6/16

CULTURAL CENTRE CULTUREL
MUSEE MUSEUM
PORT-VILA-VANUATU

Appendix B: Information Sheets and Consent Forms for Principals in Ha'apai and Port Vila

+642102537505

emma.puloka@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

14th of July, 2015

Project Title: Students' Conceptualizations of Environmental Issues: *talanoa* from Ha'apai

Information Letter for Principals

Dear

Thank you for taking the time to read this. My name is Emma Puloka and I am conducting research for my Masters of Education. The aim is to explore how Form 4 students understand environmental issues and how these are presented to them in science classes. I would like to humbly ask if your school could participate in this research. This would involve inviting two form 4 science teachers in your school to participate, who would let me observe at least 3 of their science classes where I will take observation notes but no audio recordings. These observation notes will focus on the pedagogies teachers use, what topics are being covered in class and how students are being engaged. I would also hold two audio recorded discussions with these teachers twice outside of class times lasting around one hour each. Teachers would be asked to recommend 4 of their students to also participate in audio recorded discussions with me. I would have two of audio recorded discussions in a group setting with the students lasting one hour each and another audio recorded individual discussion with me lasting about 30 minutes. These discussions will be held outside of class time. Students must provide their parents/guardians with an information sheet on the research and obtain their signature before participating. Participating teachers and students will also be asked to provide any available science lesson plans, lab or note books that I can photocopy/scan selected parts from. Copies of these documents will be securely stored and may only be seen by me and by any of my research assistants.

Participation in this research is voluntary. Any participating teachers and students have the right to withdraw from the study at any time without penalty. If participants from your school withdraw, I will do my best to remove any information relating to them, provided this is practically achievable. Results from this research will be used in my thesis and may be published and/or presented at conferences. I will take particular care to ensure the confidentiality of all data gathered for this study. I will also take care to ensure your anonymity in publications of the findings. Any audio recordings made will only be heard by me and any research assistants. All the data will be securely stored for five years following the study. It will then be destroyed. Since we may discuss some sensitive issues, including the effects of Cyclone Ian, the contact details for a local counselling group will be provided to all participants. Participants can also request to receive a report on the study.

This project has been approved by the University of Canterbury Educational Research Human Ethics Committee. If you have a complaint about the study, you may contact The Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz). If you have any questions about this research please contact me (details above) or my supervisor, Prof. Lindsey Conner at lindsey.conner@canterbury.ac.nz. If you would like your school to join this research, please read and complete the consent form provided and return it to me within 3 days. Thank you for your consideration.

Faka'apa'apa atu, Emma Puloka

+642102537505

Email: emma.puloka@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Project Title: Students' Conceptualizations of Environmental Issues: *talanoa* from Ha'apai

Consent Form for Principal
Please tick each statement that you agree with.

☐ I have read and understood the information provided to me about this project and have been given a chance to ask any questions about it.

☐ I understand what will be required of the participants from my school if we join this study.

☐ I agree that participation is voluntary and I understand that all participants have the right to withdraw from this research at any time without penalty.

☐ I agree that results from this research may be published and/or presented and that my school and any of our names will not be identified in this research.

☐ I understand that participating teachers and students can receive a report on this study.

☐ I understand that audio recordings will be made during the discussions with the researcher and that these will be securely stored along with any copies of documents provided by any participating teachers and students. These will all be destroyed 5 years after the study.

☐ I understand that if I require further information I can contact the researcher, Emma Puloka. If I have any complaints, I can contact the Chair of the University of Canterbury Educational Research Human Ethics Committee.

By signing below, I agree that I am willing for members of my school to participate in this research project.

Full Name (Principal) _____ School _____

Signature _____ Date _____

Please return this completed consent form to the researcher within three days.

emma.puloka@pg.canterbury.ac.nz

24th of June, 2016

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Project Title: Exploring conceptualizations of environmental issues in science classes: *talanoa* from the South Pacific

Information Letter for Principals

Dear _____, ,

My name is Emma Puloka and I am conducting research for my PhD in Science Education. The aim is to explore how Form 4 (Year 10) students understand local environmental issues and how these are presented to them in science classes. I would like to humbly ask if your school could participate in this research. This would involve inviting one form 4 science teacher in your school to participate, whose science class I can observe at least 3 times where I will take observation notes of the science class but no audio recordings. These observation notes will focus on the pedagogies teachers use, what topics are being covered in class and how students are being engaged. I would also hold two audio recorded discussions with this teacher and another teacher from a different school twice outside of class times lasting around one hour each. The teacher would also be asked to please recommend 3 of their students to also participate in audio recorded discussions with me. I would have two of audio recorded discussions in a group setting with the students lasting at most one hour each. These discussions will be held outside of class time. Students must provide their parents/guardians with an information sheet on the research and obtain their signature before participating. Participating teachers will also be asked to provide any available science lesson plans, lab or note books that I can photocopy/scan selected parts from. Copies of these documents will be securely stored and may only be seen by myself, my supervisors and by any of my research assistants.

Participation in this research is voluntary. Any participating teachers and students have the right to withdraw from the research at any time without penalty. If participants from your school withdraw, I will do my best to remove any information relating to them, provided this is practically achievable. Results from this research will be used in my thesis and may be published and/or presented at conferences. I will take particular care to ensure the confidentiality of all data gathered for this study. I will also take care to ensure your anonymity in publications of the findings. Any audio recordings made will only be heard by me and any research assistants. All the data will be securely stored for five years following the study. It will then be destroyed. Participants can also request to receive a report on the study.

This project has been approved by the University of Canterbury Educational Research Human Ethics Committee. If you have a complaint about the study, you may contact The Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz). If you have any questions about this research please contact me (details above) or my supervisor, Prof. Lindsey Conner at lindsey.conner@canterbury.ac.nz. If you would like your school to join this research, please read and complete the consent form provided and return it to me within one week from today. Thank you for your consideration.

Kind regards,

Emma Puloka

Email: emma.puloka@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Project Title: Exploring conceptualizations of environmental issues in science classes: t*alanoa* from the South Pacific

Consent Form for Principal

Please tick each statement that you agree with.

- ☐ I have read and understood the information provided to me about this project and have been given a chance to ask any questions about it.
- ☐ I understand what will be required of the participants from my school if we join this study.
- ☐ I agree that participation is voluntary and I understand that all participants have the right to withdraw from this research at any time without penalty.
- ☐ I agree that results from this research may be published and/or presented and that my school and any of our names will not be identified in this research.
- ☐ I understand that participating teachers and students can receive a report on this study.
- ☐ I understand that audio recordings will be made during the discussions with the researcher and that these will be securely stored along with any copies of documents provided by any participating teachers and students. These will all be destroyed 5 years after the study.
- ☐ I understand that if I require further information I can contact the researcher, Emma Puloka. If I have any complaints, I can contact the Chair of the University of Canterbury Educational Research Human Ethics Committee.

By signing below, I agree that I am willing for members of my school to participate in this research project.

Full Name (Principal) _____ School _____

Signature _____ Date _____

Please return this completed consent form to the researcher within three days.

Appendix C: Information sheets and Consent Forms for Teachers in Ha'apai and Port Vila

[Tongan phone number]

emma.puloka@pg.canterbury.ac.nz

_____, 2015

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Project Title: Students' Conceptualizations of Environmental Issues: *talanoa* from Ha'apai

Information Letter for Teachers

Dear _____

Thank you for your interest. My name is Emma Puloka and I am conducting research for my Masters of Education. The aim is to explore how Form 4 students understand environmental issues and how these are presented to them in science classes. I would like to humbly ask if one of your science classes could join this study. This would involve:

- Observing at least 3 of your science class times. Observation notes will be taken but no recordings.
- Two discussions with you and another teacher outside of class time, with each one lasting around an hour.
- I will also ask you to recommend four of your students I could invite to join in three discussions with me. Also, to please collect their consent forms and assist me in answering any questions their parents may have.

Participation in this research is voluntary. If you do participate, you have the right to withdraw from the study at any time without penalty. If you withdraw, I will do my best to remove any information relating to you, provided this is practically achievable. Results from this research will be used in my thesis and may be published and/or presented at conferences. I will take particular care to ensure the confidentiality of all data gathered for this study. I will also take care to ensure your anonymity in publications of the findings. During our discussions, I will make audio recordings that will only be heard by me and any research assistants. All the data will be securely stored for five years following the study. It will then be destroyed. Since we may discuss some sensitive issues, including the effects of Cyclone Ian in 2014, every person in the group is asked to respect each other and not share what was said with others outside the group. If you would like to continue discussions with a counsellor about anything we have discussed, please contact [Tongan counselling group] at [contact details] as they are aware of this project and are willing to support in any way they can. If you participate and would like a report on the study, please leave your email address on the consent form.

This project has been approved by the University of Canterbury Educational Research Human Ethics Committee. If you have a complaint about the study, you may contact The Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz). If you have any questions about this research please contact me (details above) or my supervisor, Prof. Lindsey Conner at lindsey.conner@canterbury.ac.nz.

If you would like to join this research, please read and complete the consent form provided and return it to me within 3 days. Thank you for your consideration.

Faka'apa'apa atu,

Emma Puloka

[Tongan phone number]

Email: emma.puloka@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Project Title: Students' Conceptualizations of Environmental Issues: *talanoa* from Ha'apai

Consent Form for Teachers (Ko e pepa ke fakaha ai 'a e loto ki ai 'a e kau faiako)
Please tick each statement that you agree with.

☐ I have read and understood the information provided to me about this project and have been given a chance to ask any questions about it.

☐ I understand what will be required of me if I join this project.

☐ I agree that participation is voluntary and I understand that I have the right to withdraw from this research at any time without penalty.

☐ I agree that results from this research may be published and/or presented and that my school and my name will not be identified in this research.

☐ I understand that I can receive a report on this study and can leave my email to receive this.

☐ I understand that audio recordings will be made during the group and/or individual discussions with the researcher and that these will be securely stored.

☐ I understand that if I require further information I can contact the researcher, Emma Puloka. If I have any complaints, I can contact the Chair of the University of Canterbury Educational Research Human Ethics Committee.

By signing below, I agree to participate in this research project.

Full Name (Teacher) _____ School _____

Signature _____ Date _____

Email address (optional) _____

Please return this completed consent form to your school secretary within three days.

emma.puloka@pg.canterbury.ac.nz

_____, 2016

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Project Title: Exploring conceptualizations of environmental issues in science classes: *talanoa* from the South Pacific

Information Letter for Teachers

Dear _____

My name is Emma Puloka and I am conducting research for my PhD in Science Education. The aim is to explore how Form 4 (Year 10) students understand environmental issues and how these are presented to them in science classes. I would like to invite one of your science classes to join this study. This would involve:

- Observing at least 3 of your science class times. No audio recordings will be taken during this time but observation notes will be taken focusing on ways of teaching and student engagement with topics presented.
- Two audio recorded, hour long discussions with you and a Form 4 teacher from another school.
- Recommend three of your students I could invite to join in three audio recorded discussions with me. Also, to please collect student consent forms and assist me in answering any questions their parents may have.
- Providing me with any available lesson plans from your class as well as any students' science lab, note books and assessments that I can photocopy/scan selected parts of. Copies of these documents will only be seen by myself, my supervisors and any research assistants I may have.

Participation in this research is voluntary. If you do participate, you have the right to withdraw from the study at any time without penalty. If you withdraw, I will do my best to remove any information relating to you, provided this is practically achievable. Results from this research will be used in my thesis and may be published and/or presented at conferences. I will take particular care to ensure the confidentiality of all data gathered for this study. I will also take care to ensure your anonymity in publications of the findings. The audio recordings made during out discussions will only be heard by me and any research assistants. All the data will be securely stored for five years following the study. It will then be destroyed. Every participant is asked to respect each other and to treat everything shared in the group as confidential. If you would like a report on the study, please leave your email address on the consent form.

This project has been approved by the University of Canterbury Educational Research Human Ethics Committee. If you have a complaint about the study, you may contact The Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz). If you have any questions about this research please contact me (details above) or my supervisor, Prof. Lindsey Conner at lindsey.conner@canterbury.ac.nz. If you would like to join this research, please read and complete the consent form provided and return it to me within 3 days. I appreciate your interest and thank you for your consideration.

Kind regards,

Emma Puloka

Email: emma.puloka@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Project Title: Exploring conceptualizations of environmental issues in science classes: t*alanoa* from the South Pacific

Consent Form for Teachers

Please tick each statement that you agree with.

- ☐ I have read and understood the information provided to me about this project and have been given a chance to ask any questions about it.
- ☐ I understand what will be required of me if I join this project.
- ☐ I agree that participation is voluntary and I understand that I have the right to withdraw from this research at any time without penalty.
- ☐ I agree that results from this research may be published and/or presented and that my school and my name will not be identified in this research.
- ☐ I understand that I can receive a report on this study if I provide my email address below.
- ☐ I understand that audio recordings will be made during the discussions with the researcher and that these will be securely stored along with any copies of documents provided by myself and my students. These will all be destroyed 5 years after the study.
- ☐ I understand that if I require further information I can contact the researcher, Emma Puloka. If I have any complaints, I can contact the Chair of the University of Canterbury Educational Research Human Ethics Committee.

By signing below, I agree to participate in this research project.

Full Name (Teacher) _____ School _____

Signature _____ Date _____

Email address (optional) _____

Please return this completed consent form to your school secretary within three days.

Appendix D: Information Sheets and Consent Forms for Parents and Students in Ha'apai and Port Vila

[Tongan phone number]

emma.puloka@pg.canterbury.ac.nz

_____, 2015

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Project Title: Students' Conceptualizations of Environmental Issues: *talanoa* from Ha'apai

Information Letter for Parents/Guardians

Dear _____,

Thank you for taking time to read this letter. My name is Emma Puloka and I am doing research for my Masters of Education. This research aims to find out how Form 4 students in Ha'apai understand environmental issues and how these are presented in their classes. As part of this study, I hope to observe two different Form 4 science classes and have discussions with teachers and students outside of class time. I would like to humbly ask if [name of student] would be able join my research. If your child is willing to join, they will be asked to:

- Join in two group discussions outside of class time at school (about 1 hour each)
- Continue discussions with me individually at school (about 30 minutes)
- Get permission from their parents/guardians

It is not a must for your child to join this research, as participation is voluntary. If they are willing to join and you agree they can join, they can leave the discussion or research at any time without penalty. If they withdraw, I will do my best to remove any information relating to them, provided this is practically achievable. Results from this research will be used in my thesis and may be published and/or presented at conferences. I will do my best to make sure all names (including the school) are not published and remain confidential. During discussions with the participating students, I will make audio recordings that will only be heard by me and any research assistants. All the data will be securely stored for five years following the study. It will then be destroyed. We may discuss sensitive issues, such as the effects of Cyclone Ian in 2014, so everyone in the group is asked to respect each other and not share about what was said to others outside. If any of the participants would like to continue talking with a counsellor about anything we discuss, they may contact [Tongan counselling group] at [contact details] as they know about this research and are willing to support in any way they can. Participants will be able to receive a report on this study if they wish.

This project has been approved by the University of Canterbury Educational Research Human Ethics Committee. If you have a complaint about the study, you may contact the Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz). If you have any questions about this research please contact me (details above) or my supervisor, Professor Lindsey Conner at lindsey.conner@canterbury.ac.nz. If you would like your child to join this research please read and sign the Student Consent Form that your child will complete. It is asked that your child please return the consent form to their Form 4 Science teacher within 3 days. Thank you for your consideration.

Faka'apa'apa atu,

Emma Puloka

Kaveinga: Ko e fakakaukau ‘a e fanau ako ki he ngaahi faingata’a ‘i he ‘atakai: ko e talanoa mei Ha’apai

KO E TOHI KI HE MATU’A MO E KAU TAUHI-FANAU

Si’i Matu’a/Tauhifanau,

Ko e tohi ni ko ‘eku kole ngofua ki he matu’a mo e kau tauhifanau koe’uhi ko e ki’i feinga ako ‘oku ou lolotonga fai . Ko hoku hingoa ko Emma Puloka pea ‘oku ‘i Ha’apai ni ke fakahoko eku ki’I fakatotolo ‘eku polokalama ako MA ‘i he Univeesiti Canterbury, Nuu Sila. Ko e taumu’a ‘o e fakatotolo ko eni ko eku feinga *ke u ‘ilo pe koe ha ‘a e lau ‘a e fanau ako foomu 4 ki he ngaahi faingata’a ‘oku hoko ‘I honau ‘atakai pea ‘oku anga fefe enau ako ki he ngaahi faingata’a ko eni ‘i ‘apiako.* Koia ai ‘oku ou faka’amu ke u vakai’i ‘a e ongo kalasi foomu 4 Saienisi ‘e ua, ‘a e kau faiako mo e fanauako ‘o fai ha potalanoa mo kinautolu hili enau ngaahi kalasi. Ko eku faka’amu ke u ma’u ha ngofua mei he ngaahi matu’a/kau tauhi fanau ke u lava ‘o faka’eke’eke ho’o ta’ahine pe ko ho’o tamasi’i fekau’aki mo eku fakatotolo ki he ngaahi faingata’a ‘o e ‘atakai. Kapau ‘e loto ho’o ta’ahine pe ko ho’o tamasi’i foomu 4 ke tali fehu’i ‘i he ‘eku fakatotolo ko e ngaahi me’a eni ‘oku ou palani ke fakahoko:

1. Ko enau ngaue ‘i he kulupu e ua hili ‘a e ako ke nau talanoa’i ‘a e kaveinga ‘eku fakatotolo (houa 1)
2. Te u talanoa fakafo’ituitui mo e fanau ako ‘oku nau loto ke nau tokoni mai ‘o tali ‘a e ngaahi fehu’i fekau’aki mo e fakatotolo (minite 30)
3. ‘Oku ou faka’amu ke fakamo’oni mai ‘a e matu’a/kau tauhi fanau ‘oku nau loto ke tali fehu’i enau fanau fekau’aki mo e fakatotolo ‘oku ou fai

‘Oku ou faka’amu pe ke mahino ki he ngaahi matu’a/tauhi fanau ‘oku ‘ikai ‘uhinga ke fakamalohi’i ha taha ke tali fehu’i ‘oku ‘ikai loto ki ai. Koia ai, ‘oku lava pe ke nofo ha ta’ahine pe tamasi’i ako ‘o ‘oua toe hoko atu ene tali fehu’i, neongo pe ne ‘osi loto ia kiai. Ka lava ‘a e fakatotolo, te u fa’u leva ha fakamatala ‘o ngaue’aki ‘a e ngaahi tali ‘a e fanau ako, ka he’ikai ke faka’asi honau hingoa pe ko ha fa’ahinga fakamatala ‘oku ‘ikai ke nau loto ke paaki mo tufaki. ‘E hiki tepi foki ha konga ‘o e fakatotolo ni pea te u fakapapau’i ‘e ‘ikai uesia ‘a e fanau ako na’e tokoni mai koeuhi ko ha fa’ahinga fakamatala te u fai. Kapau ‘e fiema’u e he fanau ako na’e tokoni ki he’eku fakatotolo ha tatau eku fakamatala ‘e fakahoko pea te u fiefia ke faka’inasi kinautolu ai.

Ko e fakatotolo ‘oku ou fai, ko e polokalama ako ia mei he ‘Univeesiti ‘o Canterbury ‘I he va’a Fakatotolo Fakaako ‘a e Komiti Human Ethics. Ka ka ‘iloange te ke tala’a fekau’aki pea moe fakatotolo ‘oku ou fakahoko, pea e lava pe ke ke fai ha tohi launga ki he Sea ‘o e Komiti Fakatotolo ‘i he Human Ethics ‘o e Univeesiti ‘o Canterbury. Ko e tu’asila eni: Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz). Pea kapau leva ‘oku i ai pe ha’o toe fehu’i kehe pea ke fetu’utaki mai pe kiate au ‘i he tu’asila ‘oku ha atu ‘i ‘olunga. Pe ko ho’o fetu’utaki ki he tokotaha ‘oku ne tokanga’i eku polokalama ako, a ia ko Professor Lindsey Conner (lindsey.conner@canterbury.ac.nz).

Koia ai ‘oku ou kole atu, kapau mu’a ‘oku ke lotolelei pe ke kau ho’o tamasi’i pe ta’ahine ki he tali fehu’i ‘i he eku polokalama fakatotolo, pea ke kataki ‘o fakamo’oni mai he tohi ko eni ‘oku tufa atu. Pea kataki mu’a ke fakafoki mai ‘a e tohi koia ‘oku fakaha mai ai ho’o loto ke kau ho’o tamasi’i pe ta’ahine ‘i he tali fehu’i ki he eku fakatotolo ki he faiako Foomu 4 Saienisi ‘i he hili pe ho’o fakamo’oni. ‘Oku ou fakamalo atu ‘aupito ‘i ho’o tokoni mai.

Faka’apa’apa atu,

Emma Puloka

[Tongan phone number]

emma.puloka@pg.canterbury.ac.nz

_____, 2015

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Project Title: Students' Conceptualizations of Environmental Issues: *talanoa* from Ha'apai

Information Letter for Students

Dear _____,

Thank you for taking time to read this letter. My name is Emma Puloka and I am doing research for my Masters of Education. This research aims to find out how Form 4 students in Ha'apai understand environmental issues and how these are presented in their classes. As part of this study, I hope to observe two different Form 4 science classes and have discussions with teachers and students outside of class time. I would like to humbly ask if you would be willing to join my research. If you are willing to join, you will be asked to:

- Join in two group discussions outside of class time at school (about 1 hour each)
- Continue discussions with me individually at school (once for about 30 minutes)
- Take an information letter and consent form to your parents/guardians

It is not a must for you to join this research, as participation is voluntary. If you and your parents/guardians agree that you can join and you are willing to, you can leave the discussion or research at any time without penalty. If you withdraw, I will do my best to remove any information relating to you, provided this is practically achievable. Results from this research will be used in my thesis and may be published and/or presented at conferences. I will do my best to make sure all names (including the school) are not published and remain confidential. During all our discussions, I will make audio recordings that will only be heard by me and any research assistants. All the data will be securely stored for five years following the study. It will then be destroyed. We may discuss sensitive issues, such as the effects of Cyclone Ian in 2014, so everyone in the group is asked to respect each other and not share about what was said to others outside. If you would like to continue talking with a counsellor about anything we discuss, you may contact [Tongan counselling group] at [contact details] as they know about this research and are willing to support in any way they can. If you participate and would like a report on this study, please leave your email address on the consent form.

This project has been approved by the University of Canterbury Educational Research Human Ethics Committee. If you have a complaint about the study, you may contact the Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz). If you have any questions about this research please contact me (details above) or my supervisor, Professor Lindsey Conner at lindsey.conner@canterbury.ac.nz. If you would like to join this research please read and complete the consent form provided and return it your Form 4 science teacher within 3 days. Thank you for your consideration.

Faka'apa'apa atu,
Emma Puloka

[Tongan phone number]

Email: emma.puloka@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Project Title: Students' Conceptualizations of Environmental Issues: *talanoa* from Ha'apai

Consent Form for Students (Ko e pepa ke fakaha ai 'a e loto ki ai 'a e fanau ako)
Please tick each statement that you agree with.

☐ I have read and understood the information provided to me about this research and have been given a chance to ask any questions about it.

☐ I understand what will be required of me if I join this project.

☐ I agree that participation is voluntary and I understand that I have the right to withdraw from this research at any time without penalty.

☐ I agree that results from this research may be published and/or presented and that my school and my own name will not be identified in this research.

☐ I understand that I can receive a report on this study if I write my email address below.

☐ I understand that audio recordings will be made during our group and/or individual discussions with the researcher and these will be securely stored and destroyed.

☐ I understand that if I require further information I can contact the researcher, Emma Puloka. Also, if I have any complaints, I can contact the Chair of the University of Canterbury Educational Research Human Ethics Committee.

By signing below, I agree to participate in this research project.

Full Name (student) _____ Student Signature_____

Parent/Guardian's signature _____ Date _____

Science Teacher Name _____ Email address (optional) _____

Please return this completed consent form to your science teacher within three days.

[Tongan phone number]

Email: emma.puloka@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Kaveinga: Ko e fakakaukau ‘a e fanau ako ki he ngaahi faingata’a ‘i he ‘atakai: ko e talanoa mei Ha’apai

Ko e foomu pe ‘oku loto ‘a e fanau ako ke nau tokoni ki he tali fehu’i ‘i he fakatotolo ako ‘a Emma Puloka

Fanau ako, kataki ‘o tiki ‘a e puha ke fakahaa’aki ho’o loto ki he ki’i fakamatala ‘oku tu’u he ve’e puha taki taha.

□ Na’a ku ‘osi lau pea mahino kiate au ‘a e polokalama ako fakatotolo ko eni, pea na’e omi pe ‘a e faingamalie ke u fai ha fehu’i ‘i ha me’a na’e ‘ikai mahino kiate au.

□ ‘Oku mahino kiate au ‘a e taumu’a ‘o e fakatotolo ko eni.

□ ‘Oku mahino kiate au na’a ku fili tau’ataina pe keu kau ‘i tali fehu’i ko eni, pea he’ikai ha fa’ahinga mo’ua ‘e hoko ‘o ka ‘ikai te u fakakakato ‘a e fiema’u ‘a e fakatotolo ‘i he polokalama ako ko eni.

□ ‘Oku mahino kiate au ‘e paaki ‘a e fua ‘o e fakatotolo ni, ka he’ikai te u uesia ai pe ko hoku ‘apiako.

□ ‘Oku mahino kiate au kapau te u fiema’u ha lipoti fekau’aki mo e ola ‘o e fakatotolo ni pe ke u fakafonu ‘a e foomu ‘oku ha ‘i lalo.

□ ‘Oku mahino kiate au ko ‘eku ngaahi fakamatala na’e hiki tepi ‘e ‘ikai toe ngaue’aki ia ki ha me’a kehe, pea ‘e faka’auha ‘a e ngaahi tepi ‘i he hili ‘a e ta’u e 5 ‘a e lava ‘o e fakatotolo ni.

□ ‘Oku mahino kiate au kapau te u toe fiema’u ha fakamatala te u lava ‘o fetu’utaki kia Emma Puloka, pea ka ‘i ai ha me’a te u ta’efiemalie ki ai, te u lava pe ‘o fakafetu’utaki ki he va’a Fakatotolo Fakaako ‘o e Komiti Human Ethics.

‘Oku fakaha ‘eku loto ke u tokoni ‘i he polokalama ako fakatotolo ko eni ‘aki ‘eku tohi hoku hongoa mo fakamo’oni ‘i he foomu ‘oku ‘asi atu.

Hingoa kakato (fanau ako) _____ Fakamo’oni ‘a e taha ako _____

Fakamo’oni ‘a e matu’a/tauhi fanau_____ ‘Aho _____

Hingoa ‘o e faiako Saienisi _____ Email address _____

Kataki pe ‘o fakafoki ‘a e foomu ko eni ki ho’o faiako Saienisi hili pe ho’o lau mo ho’o fakamo’oni ‘o kapau ‘oku ke loto ki ai.

emma.puloka@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

_____, 2016

Project Title: Conceptualizations of Local Environmental Issues from Students of the South West Pacific Basin

Information Letter for Parents/Guardians

Dear _____,

Thank you for taking time to read this letter. My name is Emma Puloka and I am doing research for my Masters of Education. This research aims to find out how Form 4 students understand environmental issues and how these are presented in their classes. As part of this study, I hope to observe two different Form 4 science classes and have discussions with teachers and students outside of class time. I would like to humbly ask if your child would be able join my research. If your child is willing to join, they will be asked to:

- Join in two group discussions outside of class time at school which will be audio recorded (about 1 hour each)
- Get permission from their parents/guardians by asking for your signature on the consent form

It is not a must for your child to join this research, as participation is voluntary. If they are willing to join and you agree they can join, they can leave the discussion or research at any time without penalty. If they withdraw, I will do my best to remove any information relating to them, provided this is practically achievable. Results from this research will be used in my thesis and may be published and/or presented at conferences. I will also take care to ensure you and your child's anonymity in publications of the findings. During discussions with the participating students, I will make audio recordings that will only be heard by me and any research assistants. All the data will be securely stored for five years following the study. It will then be destroyed. Everyone joining in the research is asked to respect each other and not share about what was said to others outside. Students who join will be able to receive a report on this study if they wish by leaving their email address with the researcher.

This project has been approved by the University of Canterbury Educational Research Human Ethics Committee. If you have a complaint about the study, you may contact the Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz). If you have any questions about this research please contact me (details above) or my supervisor, Professor Lindsey Conner at lindsey.conner@canterbury.ac.nz. If you would like your child to join this research please read and sign the Student Consent Form that your child will complete. It is asked that your child please return the consent form to their Form 4 Science teacher within 3 days. Thank you for your consideration.

Kind regards,
Emma Puloka

emma.puloka@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

24th of June, 2015

Project Title: Exploring conceptualizations of environmental issues in science classes: t*alanoa* from the South Pacific

Information Letter for Students

Dear _____,

My name is Emma Puloka and I am doing research for my PhD in Science Education. I want to find out how Form 4 students in Port Vila understand environmental issues and how these are presented in their science classes. I hope to visit two different Form 4 science classes in Port Vila and take notes on how the classes go. Also, I will talk with some teachers and students outside of class time. Would be willing to join in this research project? If you are willing to join, you will be asked to:

- Join in two group discussions outside of class time at school which will be audio recorded (about 1 hour each)
- Take an information letter and consent form to your parents/guardians and ask them to sign it if they agree

It is not a must for you to join this research, as participation is voluntary. If you and your parents/guardians agree that you can join and you are willing to, you can leave the research at any time without penalty. If you don't want to join the research anymore, I will do my best to clear any information about you, if it is practically achievable. Results from this research will be used in my thesis and may be published and/or presented at conferences. I will take care to ensure your anonymity in publications of the findings. I will make audio recordings during our discussions that will only be heard by myself, my supervisors and any research assistants. All the data will be securely stored for five years following this research and then it will be destroyed. Anyone joining in the research is asked to respect each other and treat everything that is said in the group as confidential. If you join this research and would like a report on it, please let me know on the consent form.

This project has been approved by the University of Canterbury Educational Research Human Ethics Committee. If you have a complaint about the study, you may contact the Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz). If you have any questions about this research please contact me (details above) or my supervisor, Professor Steven Ratuva at steven.ratuva@canterbury.ac.nz. If you would like to join this research please read and complete the consent form provided and return it your Form 4 science teacher within 3 days. Thank you for taking time to read this.

Many thanks,
Emma Puloka

Email: emma.puloka@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Project Title: Exploring conceptualizations of environmental issues in science classes: t*alanoa* from the South Pacific

Consent Form for Students: Please tick each statement that you agree with.

□ I have read and understood the information provided to me about this research and have been given a chance to ask any questions about it.

□ I understand what will be required of me if I join this project.

□ I agree that participation is voluntary and I understand that I have the right to withdraw from this research at any time without penalty.

□ I agree that results from this research may be published and/or presented and that my school and my own name will not be identified in this research.

□ I understand that I can be emailed a report on this study if I write my email address below or I can pick up a hard copy of the report from school (they will inform me).

□ I understand that audio recordings will be made during our discussions with the researcher and these will be securely stored along with any copies of notes I have provided. These will all be destroyed 5 years after the study.

□ I understand that if I require further information I can contact the researcher, Emma Puloka. Also, if I have any complaints, I can contact the Chair of the University of Canterbury Educational Research Human Ethics Committee.

By signing below, I agree to participate in this research project.

Full Name (student) _____ Student Signature_____

Parent/Guardian's signature _____ Date _____

Science Teacher Name _____ Email address (optional) _____

Do you want to receive a hard copy of the report of this study? (please circle one) Yes / No

Please return this completed consent form to your science teacher within three days.

Appendix E: Application to UC ERHEC

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Application Form for Ethical Approval of Research Projects

Educational Research Human Ethics Committee (ERHEC)

- **All** research activities undertaken by staff and higher degree students at the University of Canterbury must obtain Ethical Approval unless they meet the criteria for an exemption as listed under the Principles and Guidelines, Section 5.
- Before making an application to the ERHEC, all researchers should read the Principles and Guidelines found on their current web site: http://www.canterbury.ac.nz/humanethics/
- The Principal Researcher must be a UC staff member or student. For collaborative projects, the principal researcher is responsible for all aspects of project management, including applying for ethical approval and re-applying should circumstances relevant to this application change. All correspondence will be undertaken with the principal researcher.
- Applications to the ERHEC must be received by the Secretary **at least TWO weeks prior** to a meeting in order to be considered at that meeting.
- **Please submit one electronic copy and one hard copy (written) application to the Secretary (contact details below). Written applications may be submitted by internal post to:**

The Secretary, Educational Research Human Ethics Committee
Okeover House
University of Canterbury

Phone: (03) 364 2987, Extension 45588;
Email: human-ethics@canterbury.ac.nz

Project Details

Principal Researcher:	Emma Christine Puloka
Email Address & Postal Address	emma.puloka@pg.canterbury.ac.nz Ilam Apartments PO Box 6362 Chch 8041
Phone	021-02537505
University School / Department:	School of Educational Studies and Leadership
Associate Researcher/s:	
Project Title:	Students' Conceptualizations of Environmental Issues: talanoa from Ha'apai
Student applicants should attach a letter or memo indicating whether or not your proposal has been approved by the relevant committee or Head of Department or School.	
This has been submitted in parallel.	

1. What is the purpose of your research project?
(Please check one box only)

- ☐ Staff Research
- ☐ PhD Research
- ☒ Honours or Master's Research

Please indicate name of Supervisor/s:	Prof. Lindsey Conner

2. Description of the project

Please give a brief summary (approx. 300 words) of the nature of the proposal in lay language, including the aims/objectives/hypotheses of the project, rationale, participant description, and procedures/methods of the project:

The curriculums of Small Island Developing States (SIDS), such as Tonga, need to help their students engage with pressing environmental issues in their communities. Finding ways of responding to environmental change is especially urgent for studerts in Ha'apai (an outer island of Tonga) who are still recovering from the effects of drought and the devestating Cyclone Ian in 2014 as well as coping with development pressures which are common across Pacific Island Countries. The way these enviornmental issues are presented and understood by students in SIDS must be critically considered. This project aims to explore how Year 10 science students in Ha'apai conceptualize environmental issues. Qualitative narrative inquiry will be used to gather the stories of Year 10 science teachers and students in Ha'apai. To gain an understanding of the students' contexts, classroom cbservations will be conducted and curriculum documents will be analysed. Relevant information regarding environmental issues in Ha'apai will also be sought out to build an understanding of environmental challenges and opportunities the local communities face. One school out of the few high schools in Ha'apai will invited to participate in the project. Two Form 4 (Year 10) science teachers from this school will be asked to each select four students from their form 4 science classes to be invited to participate who would be willing to share their views through Talanoa. Talanoa is comparable to unstructured interviewing that is grounded in Tongan/Pacific values in order to maintain the cultural integrity of the participants. In Talanoa, I will refrain from note taking during group and individual discussions, I will provide gifts for participants as token of appreciation and will conduct myself with humility and respect at all times which is essential in the Tongan culture. In this project, Talanoa (discussions) will take place in both group and individual settings with both teachers and students seperately. As a Tongan, I hope to contribute to the literature on using Talanoa research methodology and provide insight on how science education in Tonga, and SIDS facing similar challeges, can continue to engage students with environmental issues.

3. Which of the following categories best describe your research project?

(Please tick one box only)

- ☒ Educational or social science research involving humans
- ☐ Psychological research involving humans
- ☐ Scientific research involving humans
- ☐ Other (Please specify)

4. Will this project also require ethical approval from other bodies?

- ☐ **NO**
- ☒ **YES**

If yes, please name the body and explain how this approval has been / will be obtained in the space below. Please attach copies of relevant correspondence.

Approval from the Ministry of Education in Tonga will be required. A formal letter will be sent to the Ministry by email and by post describing the research project, including aims, participants, ethical considerations, methods and how the data will be used and stored.

5. What methods will be employed in conducting your research?

(Please tick more than one box if needed)

- ☒ Examination of normal educational practice or education instructional strategies, instructional techniques, curricula, or classroom management methods, journal, existing data, documents etc.
- ☐ Questionnaires or surveys
- ☐ Examination of medical, educational, personnel or other confidential records
- ☒ Observation (covert)
- ☐ Observation (overt)
- ☐ Structured interviews
- ☒ Unstructured interviews
- ☐ Deception – Explain why and how deception is used and provide a debriefing sheet
- ☐ Other (please specify below, stating any sigrificant aspects)

Please explain any significant aspects.

6. (a) **What are the expected ages of your participants?**

- ☐ Children (under 14)
- ☒ Young people (14-17)
- ☒ Adults (18 and over including College/University students)

(b) Will this project require approval for access to the participants from other individuals or bodies? *E.g., parents, guardians, school principals, teachers, boards, early childhood centre umbrella organisations, responsible authorities, etc.?*

- ☐ NO
- ☒ YES *(Please specify who and provide details of how this will or has been obtained)*

Yes. Approval from the Ministry of Education in Tonga will be required as previously described in question 4. Also, the time for when field work in the school will take place will be discussed with each school principal via international phone calls or emails to ensure that the research is not disruptive to the school program. A formal letter will also be provided on sight Permission will also be sought from students' parents* for them to participate in the research project. To do this, an information letter about the project will be sent home with the students and parents* will be asked to read this and sign on the consent form if they are willing that their child participate.

*or guardians

7. (a) **Anonymity of participants and confidentiality of data?**

Please tick YES or NO for each

YES	NO	
☐	☐	Will complete anonymity of participants be guaranteed?
☒	☐	Will records remain confidential and access to data be restricted?

(b) Voluntary participation and complaints procedure

Please tick YES or NO for each

YES	NO	
☒	☐	Are participants able to withdraw from the project at any time without penalty?
☒	☐	Will participants be made fully aware of the College's complaints procedure should they have any concerns regarding the researcher or the project?

*If you answered **no** to any of the question 7 above, please provide additional information below explaining why these procedures are not being followed and how potential risks to participants will be minimised.*

Given the limited number of secondary schools in Ha'apai, the type of school (Government or Church run) will not be specified as that will potentially hinder anonymity of participants.

8. **Are there any forseeable risks or possible offence to the participants?**

Please tick YES or NO for each

YES	NO	
☐	☒	Social risks
☐	☒	Legal risks
☒	☐	Psychological risks
☐	☒	Physical risks
☐	☒	Cultural, religious or moral offence
☐	☒	Any other risks

*If you answered **yes** to any of the above, please provide additional information below explaining the nature of the risk or offence, how it will be minimised and access to support services.*

The occurance of the cyclone in Ha'apai was a traumatic event as it resulted in loss of homes for many. The effects of the cyclone will be brought up in discussions with teachers and students. The contact details for support services from organisations such as Caritas Tonga, who led the national trauma counselling response after Cyclone Ian in 2014, will be provided. A representative from these support services in Ha'apai will be consulted before group and individual discussions take place to discuss my research project.

9. Are there any other ethical issues that should be drawn to the attention of the Educational Research Human Ethics Committee?

☒ **NO**
☐ **YES**

*If you answered **yes**, please provide additional information below explaining the ethical issue(s) and how it will be addressed.*

10. Participant information sheet

Please attach a copy of the Information Sheet that you will provide to participants in your study.

The Educational Research Human Ethics Committee has strict but simple requirements for Participant Information Sheets.

Attached. Please note that while only English versions are attached here, Tongan versions will also be provided to participants.

11. Consent Form

Please attach a copy of the consent form(s) that participants in your study will sign.

The Educational Research Human Ethics Committee has strict but simple requirements for Consent Forms. These guidelines must be followed or your application will not be considered.

Attached. Please note that while only English versions are attached here, Tongan versions will also be provided to participants.

Completed by
Prof. Lindsey Conner
13/5/2015

University of Canterbury
Educational Research Human Ethics Committee

Applicant Checklist

SECTION 1 APPLICATION FORM

Researcher's name, role and purpose given	Yes
If applicant is a student, has their proposal been submitted?	Yes
Description of the project includes: - Aims - Rationale - Description of participants including sampling strategy - Procedures and methods	Yes
Description of the project matches what is in the information sheets	Yes
Anonymity assured or explanation	Yes
Confidentiality of raw data assured	Yes
Voluntary participation	Yes
Right to withdraw assured or explained	Yes
Complaints procedure	Yes
Risks identified and covered	Yes
Any other ethical issues	Yes

SECTION 2 INFORMATION FORM(S)/LETTER(S)

CRITERIA Letter to:				
Researcher's name, role and purpose given	Yes			
Title of project	Yes			
Brief description of aim of project	Yes			
Requirements for participants clearly spelt out. - How much time - The nature of the involvement - Any special meeting requirements - Etc	Yes			
Voluntary participation	Yes			
Right to withdraw assured or explained	Yes			
Steps taken to ensure confidentiality are explained	Yes			
Secure storage of raw data and data destruction assured	Yes			
Anonymity assured or explanation of why this isn't guaranteed	Yes			
Information about use for publication, etc	Yes			
Any risks described including their remedies including conflicts of interest	Yes			
Summary of results available to participants	Yes			
Contact details for researcher (and supervisor if necessary)	Yes			

In the body of the information form, complaints procedure as follows: Complaints may be addressed to The Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch, Email: human-ethics@canterbury.ac.nz	Yes			
Consent procedure outlined	Yes			
Forms on UC Letterhead (available on ERHEC website)	Yes			
Information to participants in style appropriate to age, etc	Yes			
Other – eg compensation for participation, subsequent tasks or procedures	Yes			

SECTION 3 CONSENT FORMS

CRITERIA Form for:				
Title of project	Yes			
Statement included that notes full explanation of project has been given on information sheet and understood	Yes			
Statement included that participation is voluntary	Yes			
Statement included that participants understand that they have the right to withdraw at any time	Yes			
Agrees to publication of results with understanding that anonymity will be preserved where this has been a condition of participation	Yes			
Summary of results available to participants	Yes			
Forms on UC Letterhead (available on ERHEC website)	Yes			
Information to participants in style appropriate to age, etc	Yes			
Place for participants to sign, if applicable + parents	Yes			
Information given for return of consent form to researcher	Yes			
Other – eg covers any special provision such as waiver of confidentiality, publicly available storage of research material, or use of video and photographs	Yes			

Appendix F: University of Canterbury Ethics Approval for Case Study One (2015 Letter) and Case Study Two (2016 Letter)

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Lynda Griffioen
Email: human-ethics@canterbury.ac.nz

Ref: 2015/13/ERHEC

11 June 2015

Emma Puloka
School of Educational Studies & Leadership
UNIVERSITY OF CANTERBURY

Dear Emma

Thank you for providing the revised documents in support of your application to the Educational Research Human Ethics Committee. I am very pleased to inform you that your research proposal "Students conceptualisation of environmental issues: talanoa from Ha'apai" has been granted ethical approval.

Please note that this approval is subject to the incorporation of the amendments you have provided in your email of 9 June 2015.

Should circumstances relevant to this current application change you are required to reapply for ethical approval.

If you have any questions regarding this approval, please let me know.

We wish you well for your research.

Yours sincerely

Nicola Surtees
Chair
Educational Research Human Ethics Committee

"Please note that Ethical Approval and/or Clearance relates only to the ethical elements of the relationship between the researcher, research participants and other stakeholders. The granting of approval or clearance by the Ethical Clearance Committee should not be interpreted as comment on the methodology, legality, value or any other matters relating to this research."

F E S

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE
Secretary, Rebecca Robinson
Email: human-ethics@canterbury.ac.nz

Ref: 2015/13/ERHEC

20 April 2016

Emma Puloka
School of Educational Studies & Leadership
UNIVERSITY OF CANTERBURY

Dear Emma

Thank you for your request for an amendment to your research proposal "Students conceptualisation of environmental issues: talanoa from Ha'apai" as outlined in your email dated 13th April 2016. I am pleased to advise that this request has been considered and approved by the Educational Research Human Ethics Committee, **subject to the following changes:**

In each appropriate Information Letter, please delete the very first sentence that thanks participants for their time taken in reading the information.

Please note that should circumstances relevant to this current application change you are required to reapply for ethical approval.

If you have any questions regarding this approval, please advise.

We wish you well for your continuing research.

Yours sincerely

pp R. Robinson

Patrick Shepherd
Chair
Educational Research Human Ethics Committee

Please note that ethical approval relates only to the ethical elements of the relationship between the researcher, research participants and other stakeholders. The granting of approval by the Educational Research Human Ethics Committee should not be interpreted as comment on the methodology, legality, value or any other matters relating to this research.

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